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ENGINEERING & MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

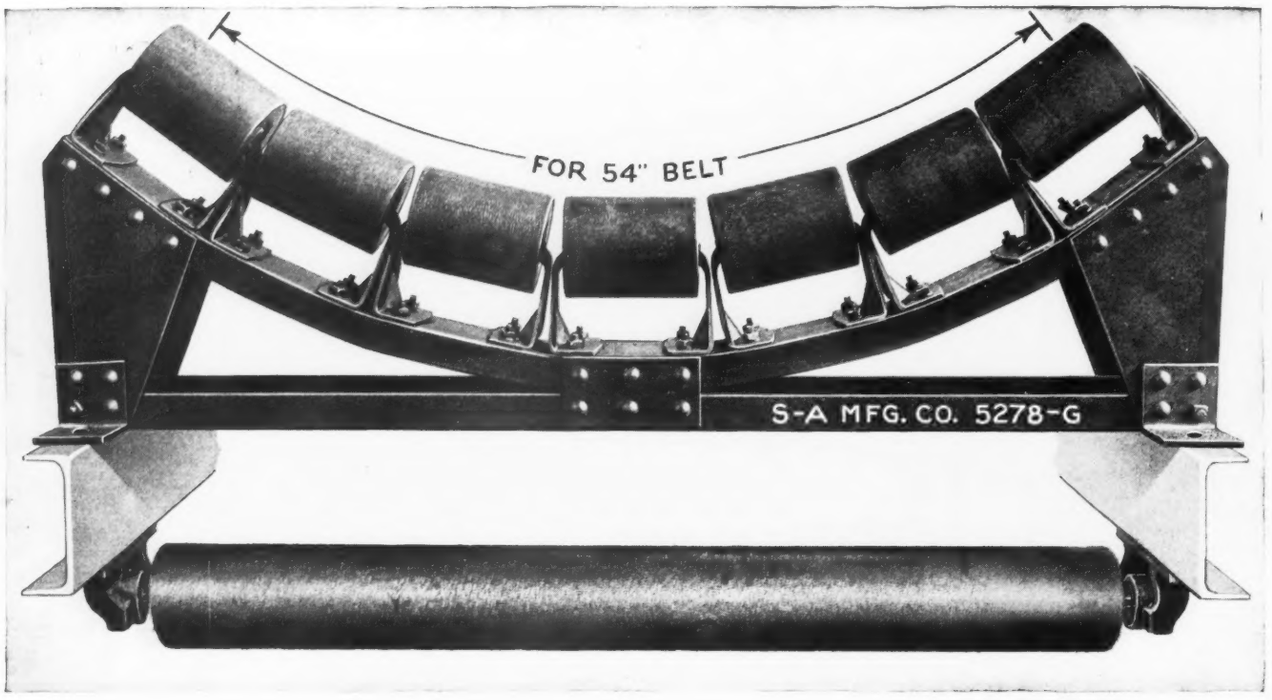
Operations of the Mesabi Iron Co. (I)—by Arthur B. Parsons

The outstanding development of the Lake Superior region. Its history and economics and the mining method employed

Has Miami-Picher Zinc District Passed the Zenith?—by Karl E. Koelker

Dust Control in Crushing Plants Important—by George E. Lynch

When Will Our European Markets Be Restored?—by Robert Murray Haig



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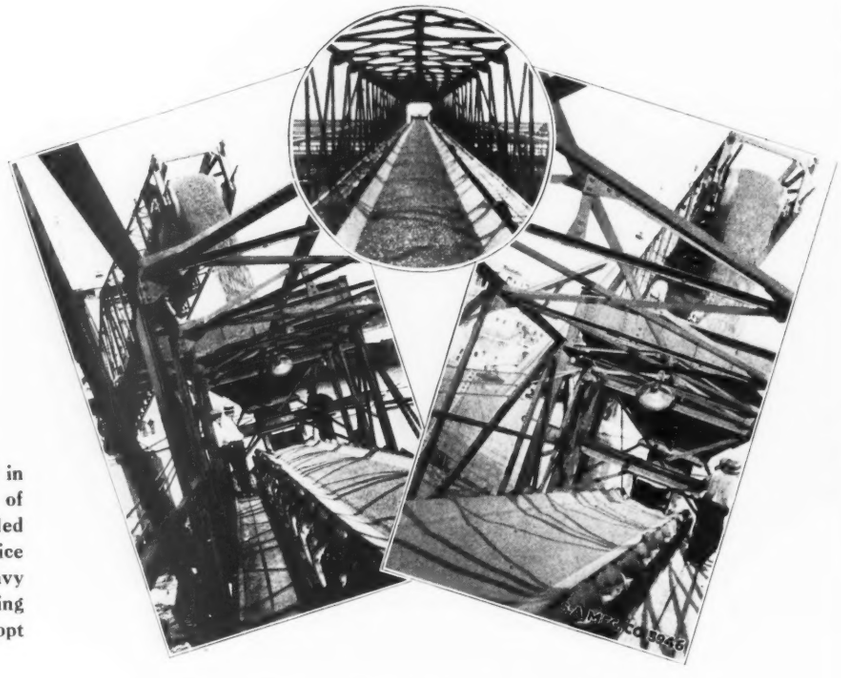

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Stephens-Adamson Mfg. Co., Aurora, Illinois

ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

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Selling the Idea

IT IS OF NO AVAIL to mine and reduce ore with all the technical skill and economy in the world, if you cannot market the metal after it is produced. Mining engineers who believe they can help the country with their ideas should bear this basic fact in mind: if they have only the ability to bring forth the wise and unbiased advice and not the ability to "put over" their opinions, it shall avail them and the world nothing. Ideas are cheap; good ideas, good plans, sound advice, are as the sands on the seashore. The salesmanship problem is where the competition comes. If you are to be of any account you must sell the country your sound idea in competition with the fakers and get-rich-quick intellectuals who are hawking tinsel wares to an open-mouthed public.

This, for example, applies to the project for mining-law revision embarked upon by engineers, and carried on for several years in the past. A comprehensive and much improved plan for amelioration of the mining laws was brought forward. But they had failed to consider the selling problem; in fact they allowed a psychology adverse to their selling it to creep in at the critical moment. A few irresponsibles in Nevada yelled "Wall Street!" and the buyer public took to the tall timber. First and most sensitive of chill-wind barometers, the Mining Congress, took to cover; then the Congressman who had introduced the bill found himself a shell-hole; then the Committee on Mines and Mining of the House of Representatives hastily disclaimed knowledge; the Bureau of Mines appealed to the Mining and Metallurgical Society of America, which surveyed the situation with puzzled and affronted dignity. It was with the last-named society that the movement arose; the idea, so long as it looked salable, was gleefully grabbed in turn by all the above-mentioned forces, only to be passed back much more swiftly when it began to burn their fingers.

Now nobody can market that particular bill as it stands, with the above noted experience as a matter of history. Reform of the mining law may be obtained, but the reform should be taken up point by point, and cautiously; the demand must come, or seem to come, from the public, to whom the reform is to be sold, and the selling job is the big one.

Reparations and Copper

ROLAND BOYDEN, unofficial delegate of the United States on the Reparations Commission, made a statement before the New England Society at its 118th annual dinner recently that should be weighed carefully by everyone in the copper industry. Speaking about the invasion of the Ruhr and the reparations impasse he said: "The difference between the original capacity of Germany to pay reparations and her present capacity to pay reparations measures approximately the direct loss suffered by the Allies by reason of this mistake. This direct loss represents billions of dollars. But unfortunately this loss does not end there. Even leaving Germany herself out of account, you must add to the direct loss more billions representing the indirect loss to the business of the world, a loss shared by all nations."

The copper industry is one of the "businesses" that fall into this category. We have already expressed in these columns the thought that the copper industry was paying a heavy price for the disordered state of political and industrial Europe; that, in fact, it was sacrificing millions of dollars (the difference between the present price of copper and what it should be, based upon the present commodity level) while the Franco-German mess continues to stew. It is interesting to see this thought substantiated by an authority who has been in close contact with developments in Europe in recent years.

The Mysterious Cost of Producing Copper

TO PARAPHRASE Bret Harte, for ways that are dark and for tricks that are vain, the methods of mine accountants are peculiar. No two seem to figure their costs in the same way. If we wish to find out what it costs a company to produce a pound of copper, we find the answer to be an equivocation. We read: "Includes depreciation, state and local tax, but not federal income tax"; "includes depreciation, state, local and part federal tax"; "after depreciation, depletion, and exploration"; "includes depreciation but not taxes"; "includes construction, income and excess profit taxes but before depletion"; "after depreciation, crediting other metals"; "includes depletion after deduction of appreciation realized during year"; "after depreciation"; "does not include depreciation"; and so on. If some one tells us that the Chile Copper Co. can produce copper cheaper than the Chino Copper Co. we may feel perfectly safe in coming back with "Is that so?" or "That all depends."

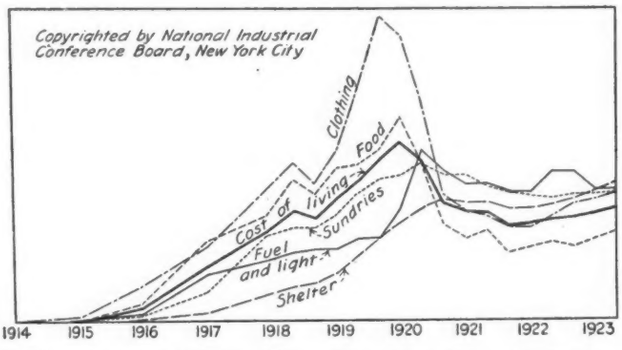
Our observations on this subject are occasioned by a marked readjustment that we were forced to make in our ranking of copper producers last week. We had always supposed that the Cerro de Pasco company should be included among the much-heralded "low-cost producers." It had appeared to us that its costs were something like 7 or 8c. per pound of copper. But on talking with a vice-president of this company we find that a change in the method of bookkeeping is in prospect. Cerro is now producing monthly about 10,000,000 lb. of copper, worth $1,250,000; 1,500,000 oz. silver worth $950,000; and 5,000 oz. gold, worth $100,000. Instead of crediting the value of the precious metals to the cost of producing copper, it is now proposed to apportion the costs to the various metals produced, whereby it is found, according to our informant, that all the profit comes from the gold and silver and that the company does well to break even on

its copper. This seems a fair way to look at it, provided the costs can be split up with a proper degree of accuracy. Most copper producers depend upon the precious metals for an important part of their profit, but with Cerro the value of these byproducts, as we might call them, is almost as much as that of the copper.

With a prospect of low copper prices for a time, investors have been urged to buy the shares of only the "low-cost producers." As to which companies these are, we suggest that our readers follow their hunches rather than sit down with pencil and paper and attempt to figure it out from a sheaf of company reports.

The Purchasing Power of Money

WAGES in the United States have been rising steadily during 1923, rather faster than the cost of living, which has also been rising, according to the National Industrial Conference Board.



These curves indicate how costs of necessaries have fluctuated since 1914

Thus wages, food, rents, and clothing are all up. In its simplest terms, this means that the value of the dollar has been and is decreasing. The last year has seen still more rapid depreciation of the pound sterling, as measured by foreign exchange in dollars; a nearly one-third shrinkage in the value of the franc; and has witnessed the utter loss of value of the mark. These various standard mediums of exchange, so far from being stabilized, are quite mercurial, and all have an alarming tendency to sink.

It means little to the workman if wages rise, as long as the cost of living also goes up in a rude proportion, which, in broad terms, it is bound to do. Those who are affected by these movements are not the wage earners, but the holders of the dollar, which brings less tomorrow than today. The fall of the mark wiped out all capitalists whose holdings were in marks. A mining engineer in Germany, whose case was reported to us, had saved 40,000 marks, or about $10,000, a snug nest egg for Germany, which he invested in mortgages before the war. Some time ago the mortgages matured, and were paid, and he received the equivalent of $12. Later on he would not have received so much. Similarly, an owner of dollars in the United States, who bought bonds or mortgages before the war, which mature nowadays, gets back less than two-thirds of his capital because of the decreased value (purchasing power) of the dollar.

The depreciation of currencies has then in effect resulted in confiscation, by the public, of wealth represented by an accumulation of money, to a greater or less degree. In Germany the owner of marks has suffered complete confiscation of his wealth; in France the owner of francs has lost three-quarters of his hoard; in the United States, one-third. No socialistic program could have been more swift and thorough.

Mining engineers, like other thrifty citizens, are students of investment. How shall they retain their savings? It is reported that the Department of Commerce recently followed out the recommendation during 1923 of a well-known statistician and investment adviser, and found that if one had taken this adviser's advice faithfully he would have lost 60 per cent of his capital during the year.

Possibly—and possibly not—a pessimistic view of the situation is to consider the German during the fall of the mark. On receiving funds he lost not an hour in buying something tangible, for an hour later he could not buy as much. Tangible wealth appears more stable than dollar wealth under present conditions. Tangible wealth includes, among other things, real estate, and the soundest common stocks, including, of course, the soundest mining stocks.

The Importance of Persistence

MANY A RECOMMENDATION has been discredited because it was acted upon in a half-hearted manner by those who would benefit; many a report aiming to secure increased output and decreased cost of production has failed in its consummation because of a lack of enthusiasm in carrying on the work along the lines suggested. The history of mining is replete with examples that show the vicissitudinous nature of the tasks undertaken and the tremendous influence that chance sometimes wields in determining ultimate success. Nevertheless, there are many instances on record to show that sound engineering advice formed the basis of profitable enterprises, the success of which has been attributed, in part or in whole, to chance. An excellent example of the value of persistence in pushing the development of a mine that appeared promising was given by Mr. E. T. McCarthy in a recent discussion on metallurgical practice in Korea at a meeting of the Institution in London.

Twenty years ago, we learn, Mr. McCarthy spent, in company with forty Koreans, a few days in the Tul Mi Chung mining district. The only habitation, a Korean hut, was three and a half miles from the mine he was examining, and the journey to and fro on foot was made in a biting cold wind and heavy sleet. He found nothing of significance underground but some old workings, long since fallen in. It was a well-mineralized contact zone, but with only one indication of ore above an exceedingly low gold content. Nevertheless, in spite of the inhospitable nature of the country, he recommended that £19,000 be spent in exploration work. This was done without finding anything, and operations ceased. Subsequently, he recommended unwatering and further expenditure on exploratory work. This was undertaken, with the result that, after only 4 ft. of driving, a lens of ore was opened up 240 ft. long and 40 ft. wide, which milled over 1 oz. gold per ton. In the first year in which work was resumed the dividends paid amounted to 25 per cent of the capitalization, the total to date being 425 per cent!

The tale of vicissitude, chance and success, however, is but half told. Shortly before the Japanese earthquake-fire this year, the Tul Mi Chung camp, near the mine, was visited by a severe cloudburst, which swept away the town, carrying death and destruction and

injury in its wake. The mill escaped damage; and the mine, strange to relate, may take on a new lease of life because of the catastrophe. An area, previously mapped as one of underlying schist, was uncovered by the flood, disclosing a limestone formation, in which prospecting work has been started. With such an example as this of the value of sound engineering advice and the benefits accruing from persistence in the face of adversity, who shall say that optimism in mining is unwarranted?

Adventures of the Bureau of Mines

THE BUREAU OF MINES in Washington has had an eventful life, and its future history is as yet uncertain. It originally was incubated, as so many other bureaus, in the Geological Survey, as a Division of Mineral Technology, and later on there was a campaign for a Department of Mines, which was compromised by the creation of the Bureau of Mines, taking the above-named division out of the Geological Survey and making it an independent bureau in the same department, that of the Interior.

Since then the Bureau has not rested easily. The ancestry as a Division of Mineral Technology determined its charter as essentially a technological bureau, and it has not been able to take up the industrial and economic phases of mining, of which the present Director sees the advisability. Also, many new proposals have been made for its placement. The project for a Department of Mines was revived by Senator Nicholson, and, after his death, by Senator Oddie. Another bill introduced some time ago proposed to create an assistant Secretary of Mines in the Interior Department, and put the Bureau of Mines and the Geological Survey thereunder. Recently the Cabinet agreed to the transference of the Bureau of Mines and the Division of Mineral Resources of the Geological Survey, to the Commerce Department. The plan awaits the sanction of Congress. It would have advantages, so long as Hoover is Secretary, of placing the mining industry under a man who understands it; and it would permit the treatment in the Commerce Department of mining as an industry. Yet the severance of the Bureau of Mines and the Geological Survey would weaken the effectiveness of mining representation in the government, and would hit especially hard the Geological Survey, whose prosperity depends upon economic justification, and which is closely associated in the minds of Congress with mining geology.

Extending the Use of Radio

IN NEW YORK the other day a party of radio experts tried out a new instrument devised for both broadcasting and receiving in unusual locations. In the heading of the vehicular tunnel now 1,000 ft. from the New York shore and 80 ft. below the surface of the Hudson they heard with ease the programs of the various local broadcasting stations. This was only an experiment, and even better results may doubtless be expected.

What was thus done beneath the Hudson can probably be done 80 ft. below the surface in any mine, and the day is probably not far hence when telephone conversation by radio will be possible between the surface and any underground point. In fires and other mine disasters this will be a great advantage.

Collection of Statistics by Trade Associations

WHAT a trade association can or cannot do appears to be still uncertain. An ex-representative of the Department of Justice at the meeting of the American Statistical Association, when interpellated by Secretary Tuthill of the Zinc Institute, said that it was not the function of the Department of Justice to define what a trade association could or could not do in the way of getting and distributing statistics, but only to prosecute when in its opinion the association had gone too far. A foolish and arbitrary attitude, certainly: but a fact to be reckoned with. Recently a "consent decree" was entered in the government's suit against the Tile Manufacturers' Credit Association, in which decree the association was permitted to "receive and compile for transmission to any government agency such information and statistics as it may request as to the production, the stocks on hand, and the price of tiles," but restrains them "from distributing said information among themselves." And from this one can draw any conclusions one wishes.

The Public Learns About Nebraska

IN A RECENT ISSUE of *The New York Herald*, under the heading "Know Your Own Country," one may learn in five minutes the outstanding facts, in a manner of speaking, about Nebraska. First we read, that "Nebraska has the only silica deposits in the United States." Well, well; it was only three years ago, according to "Silica in 1921," published by the U. S. Geological Survey, that "production was reported in California, Connecticut, Maryland, Michigan, New York, North Carolina, Pennsylvania, Washington, and Wisconsin." Further on we read that "Nebraska has no mines," which so far as we know, is an accurate report. The third paragraph which interested us particularly, stated that "the largest smelter of fine ores in the United States is in Nebraska." What do you mean, fine? Ground fine, rich in mineral, easy to smelt, or containing precious metals? On any of these points we should say that the Omaha smelter ranks distinctly below the top in point of size.

High Load Efficiency Wanted

THE Metal and Thermit Company of New York contributes the following genuine letter to the New Year's literature on doodle-bugitis:

Messrs Gold Smith Miami FLA.Dec 17TH.1923.
Termit CO.
Newyork.....NY.
Dear sirs i understand that you handle what is called Load Stone or Lodes Stone and if so i want one half pound of the Load stone powder or Loadeds Stone Power and i want a half pound piece of of the Load stone i mean the Genuine Load stone can you let me have this if so please let me know now i do not know which of those are the correctname for those goods are not Lodus or Load stone I want the kind that is the most attractive to Treasures in the ground if you have this on hand please mail the required amount to me parcel post C.O D.and obliged
your sr Respectfully
(Signed) C. S. Brannen
128 N.E. 10TH.ST.
Miami.FLA.

If a half pound of "lodestone" will draw "treasures in the ground," what, it occurs to us, would a ton do? Our mind recoils from the possibilities suggested.

Robert Murray Haig
Professor, School of Business, Columbia University

When Will Our European Markets Be Restored?

By Robert Murray Haig

"POST-WAR readjustment" and the "economic recovery of Europe" are topics in which American business men have a profound interest, and there is no group whose interest is properly more keen than the metal miners. Information bearing upon the probable effects of European recovery as well as its probable date is of great moment to these industries.

In a monograph entitled "The Tariff in an Unbalanced World," published by the Chase National Bank, Dr. B. M. Anderson has recently restated what he conceives to be the probable readjustments in the United States which are likely to follow a European revival. The most significant paragraphs follow:

"A strong restoration of Europe to full productive activity would lead to a sharp shock in the United States, with the necessity for a good deal of readjustment. Even this would be better for us than a continuance of the progressive maladjustment which is involved in having Europe on the down grade. The kind of revival which may be expected, however, is likely to be too slow rather than too rapid, and our own readjustment to it may be expected to be comparatively painless. With the restoration of Europe to full productivity, involving a great increase in the volume of goods produced and consumed in the world, we may, I think, look forward to generally lower prices of goods, in terms of gold, than now obtain. This may be accompanied by even higher prices of many farm products and raw materials, but the level of prices of manufactured goods will probably go lower.

"This would involve a shifting of our industries. Those lines of manufacturing production, in particular, which use a great deal of labor in comparison with the capital which they employ, will probably be obliged to give up part of their labor and to contract their operations. European labor is cheaper and will be cheaper than labor in the United States, especially in view of our present immigration policy, and we shall not be able to compete successfully with a restored Europe in lines of production where the labor element is large and the capital element is relatively small. We shall succeed best in those lines where labor is economized, and land and capital used more lavishly. Labor will be released in the United States from some lines of manufacturing, will shift back to agriculture, to the building trades, to copper mining, and to other lines which will be stimulated by the restoration of Europe or by a lower level of costs. This process should, however, involve no general slump, and should rather be accompanied by a general stimulus to business, based on the revival of certain lines which have been unduly depressed. Among these will be copper, zinc, the packing industry, the hide and leather industry, the fertilizer industry, and the farm implement industry, as well as the growing of grain and livestock. The change will be, moreover, in the direction of the restoration of equilibrium. It will make for a permanently balanced industrial situation, far more satisfactory and far more dependable than the temporary unstable equilibria on which we have built temporary periods of activity since the Armistice. We need not fear Europe's revival or seek to defer it by placing tariff walls in the way."

Most economists who have given thought to the problem find themselves in agreement with the position here stated. It is desirable, however, to call attention particularly to the assertion that "The kind of revival which may be expected . . . is likely to be too slow rather than too rapid." It is with respect to this element that calculations are perhaps most apt to go astray. And the error is almost certain to be in the direction of underestimating rather than overestimating the period which will be required to bring about a recovery. The situation is affected by fundamental forces which will require a very long time to change.

The complicated and delicate mechanism of international economic co-operation was shaken by the way as violently as Tokio was shaken by the recent Japanese earthquake. It wellnigh destroyed general confidence in the soundness of the policy of economic specialization among the nations. It taught this generation at least that, in this imperfect world, it is not safe to assume that the parts of any worldwide economic organization can be trusted to work together efficiently. Enormously productive as specialization may be if it can be properly controlled and co-ordinated, the fact remains that such control and co-ordination are essential conditions.

The nations appear to be still in the midst of their first instinctive reaction toward self-protection. The trend is still in the direction of national economic autonomy. It is not difficult to understand why this should be so. Russia has been ostracized for committing unforgivable sins against generally-accepted economic institutions. Germany, for a variety of reasons, has been left to stew in her own juice—or rather in a restricted portion of her own juice. We have retired to our own shores and built our tariff fences higher than before and are trying to comfort ourselves with the thought that our welfare does not necessarily depend upon that of the rest of the world. Even Great Britain, with a century of free-trade history behind her, seriously contemplates adopting the same course.

This is almost certain to be only a passing phase. The rewards in the way of increased total productivity which follow from international economic specialization are too great to be permanently ignored. There is an almost irresistible pressure of the human race to get its work done with the least possible total effort, and to attempt to raise grapes in Scotland, to use Adam Smith's old illustration, is scarcely the proper way to accomplish this. But the pressure and the movement are those of the glacier rather than those of the avalanche. The passing phase will require a long time to pass. Those who thought of it as a matter of a year or two have long ago been confounded by the facts.

It seems inevitable then that for a long time to come business plans must continue to be made on the assumption that economic recovery in Europe will be very slow and gradual. In discussing this situation recently, an eminent sociologist, who has spent a long life watching the movement of social and political forces, was asked what length of time would be required to re-establish the conditions essential to full international economic co-operation. "Put it down at fifty years at a minimum," was his advice. If this seems unduly pessimistic, let the reader ask himself what grounds he has for believing that the war has increased rather than decreased the capacity of the nations of the world to dwell together in mutual confidence and peace, and qualify the estimate to fit his answer.

Operations of the Mesabi Iron Co.—I

The Outstanding Development of the Lake Superior Region—History, Mining, and Economics

By Arthur B. Parsons
Assistant Editor

IRON DOMINATES THE WORLD. Some contend that coal is more vital, because heat is needed to make iron and steel. But there are other sources of energy, more convenient and less costly, and it is only a question of time when progress in hydro-electric development will have reached the point where coal will be but an incidental source of power and heat. Even more direct means than the generation of electricity by hydro-power eventually will be developed for making available the latent energy of the sun. But iron! Science gives not the vaguest suggestion that anything will displace iron and steel as the most essential material tool of modern civilization. Hardness, tenacity, malleability—it possesses all these in unique degree. These are some of the qualities that make steel and iron indispensable in modern industry. The domestic consumption per inhabitant of the United States has climbed uniformly from 0.18 tons in 1900, to 0.36 tons in 1922. New kinds of machines and new types of structures are being devised every year; and steel or iron is the basis of most of them.

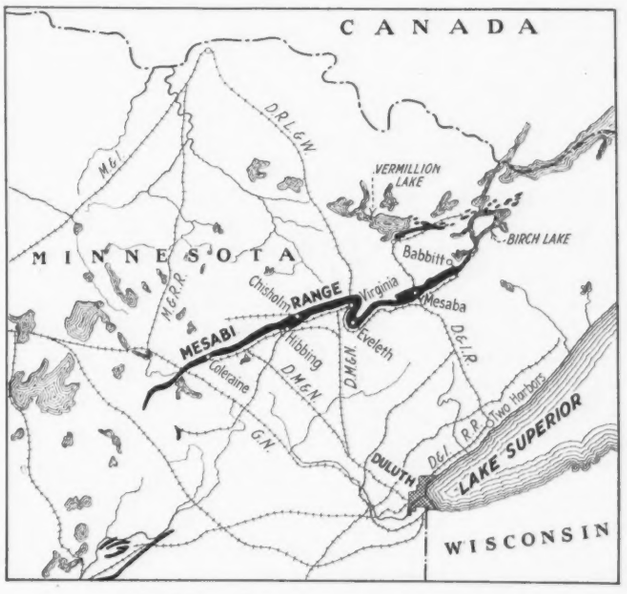
It is unlikely that Charles Hayden, Galen Stone, and D. C. Jackling reasoned along these exact lines when in 1915 they formed a syndicate to investigate a proposal to exploit the low-grade magnetite iron ores of the eastern Mesabi in Minnesota; or even when they organized the Mesabi Iron Co. in 1919 to build a commercial plant for the concentration and sintering of the ore. Nevertheless, these considerations are deeply significant to the steel industry in general, and to the Mesabi Iron enterprise in particular.

A Pioneer Enterprise

The undertaking was in a sense an experiment. Much technical pioneering was involved. Some factors in the economic equation had to be estimated from meager data. Accordingly, it is particularly interesting that the results to date demonstrate that even lower unit costs than anticipated will be realized when the intended scale of operations is reached. Additional machinery is now being installed in the fine-grinding, concentrating, and sintering departments to increase the capacity to 800 tons of finished sinter per day, a rate for which equipment in other departments is now more than ample. On this basis, careful calculations indicate that, with a comparatively small additional expenditure on capital account, a fair profit will be realized.

The far-reaching importance of the establishment of a profitable enterprise on the eastern Mesabi becomes apparent when the immensity of the deposits is considered. No accurate estimate is possible, but sane geologists have ventured to guess five billion tons of profitable magnetic ore. Others have mentioned fantastic figures that, as the prospectus writer would say, "stagger human imagination." At any rate there is plenty of 25 to 30 per cent material to supply the United States for a good many years, if enough plants were erected to concentrate it—which, of course, is impracticable.

The distinction between the ores of the eastern Mesabi and the remainder of the range is that the iron oxide is almost exclusively in the form of magnetite, whereas hematite and limonite predominate in the central and western portions. Accordingly, magnetic concentration is inapplicable there, unless of course the ore were to be roasted. The high-grade hematite deposits are the result of the leaching of siliceous constituents of the iron-bearing rocks and the resulting natural concentration. This has not occurred with the magnetite. The entire iron-bearing formation is called taconite by some; others prefer to exclude the hematite ore, but the question then arises, where shall the line be drawn? However, in this article taconite will mean magnetite ore.



Map of the Mesabi Iron Range, showing Babbitt near the eastern end

Product Must Compete With Natural Hematite Ore

No one ever has questioned seriously that these low-grade magnetite ores eventually would be mined to help in supplying the furnaces of the great interior steel districts. The question of how soon was an economic one. As the higher-grade hematite deposits gradually became depleted, either low-grade ore would have to be shipped to the furnaces or resort would have to be made to methods of improving the grade by sorting, washing, or concentration. This would necessarily increase the price for a high-grade product comparable in iron content with that which the Mesabi Iron Co. can supply. The question was, how soon would the price of standard furnace feed reach a point where the magnetic ore could be mined and beneficiated at a profit? In other words, how soon could it compete in the open market with the product of the hematite mines?

Panoramic view of the Mesabi Iron Co.'s mine at Babbitt,

It was known that by grinding the taconite finely a separation of the valuable magnetic particles could be effected. The unknown factor in the problem was the cost of mining, crushing, grinding, concentrating, drying, and sintering the extremely hard, tough ore. It is probably fair to say that most iron-mining officials and engineers in the Lake Superior region had little experience on which to base an opinion. They were essentially miners; they could get the ore into cars, either by underground or open-cut operations, economically; and they could haul it to Duluth. They had built quite a number of washing plants and some comparatively simple concentrators, but when it came to methods of efficient crushing, grinding, classifying, concentrating, and dewatering, they were pretty much in the dark.

Experience With "Porphyry" Coppers Helped

These processes, on the other hand, had been studied most carefully by the Jackling engineers in connection with their western copper operations. This knowledge, supplemented by the results of extensive experimental work on the taconite ore at a specially built 100-ton plant in Duluth, convinced Mr. Jackling that by the time that he could build a large concentrator on the range, work out the detailed problems of treatment that necessarily would arise, and bring the entire plant up to capacity, he would be able to make a high-grade product at a cost that would permit of profitable operations. The established base price in 1923 was $6.45 per ton at Lake Erie ports for 55 per cent ore (Old Range Bessemer); in addition, producers received a cumulative premium of 1c. for each per cent above the standard. That made a 64 per cent sinter worth nearly $7 per ton on Lake Erie, or about $5.75 at the mine. Since the tonnage of sinter made averages about one-third that of the ore crushed, the cost of mining and milling would have to be less than about $1.91 per ton —disregarding another source of income that I will mention later. It was concluded in 1918 that this could be done with a plant handling 2,500 tons of crude ore and making about 800 tons of sinter per day. That goal is in plain sight today.

In this article I will outline the geological features of the ore deposits, review the history of the enterprise, describe the methods of mining, and draw attention to various economic aspects of the undertaking. In a second article I will describe in some detail the operations of the concentrating and sintering plant—the "manufacturing" plant as it is sometimes styled.

The Mesabi Range extends in a northeasterly direction, from a point west of Pokegama Lake to Birch Lake, a distance of about 100 miles. The width varies from 1½ miles to 3 miles. The eastern Mesabi, as it is called, comprises the easterly 20 miles of the range. In general this part of the range is distinguished from the remainder by two characteristics: (1) The infrequent occurrences of masses of hematite in the taconite and the absence of leaching and enrichment; and (2) the comparatively thin overburden of glacial drift. It is seldom more than 6 ft. thick, and immense areas are to be found where the iron formation is actually exposed. In the central and western part of the range, the overburden varies from 30 to 200 ft. in thickness.

The taconite rocks are found as metamorphosed sedimentary beds dipping gently south and south-east at angles of about 10 deg. Irregularities resulting from faults and folding are of comparatively little importance. J. E. Spurr was the first to identify the characteristic original mineral in the iron-bearing formation as a variant of glauconite. In Bulletin 10 of the Geological Survey of Minnesota he describes the mineral and points out the low alkali content of it. C. K. Leith prepared Monograph 43 for the U. S. Geological Survey in 1903. He confirmed Mr. Spurr's conclusions and named the new mineral greenalite.

Frank F. Grout and T. M. Broderick, who made a geological report for the Minnesota Geological Survey in 1919, point out (1) that none of the igneous rocks associated with the deposits have essentially modified the iron content of the magnetite ore and (2) that most of the beds showing a concentration of iron are characterized by a conglomerate texture. In summarizing the geologic history of the deposits they say:

"Deposition (of the original sediments) occurred probably in shallow water by precipitation, mainly as an organic process, resulting in lean ferruginous cherts, with more or less siderite, ferric oxide, and greenalite. Alternating with periods of precipitation came periods of solution, leaching, oxidation, and wave action, producing intraformational conglomerates, granular rocks much richer in iron, and probably some layers of pure ferric oxide.

Magnetite in Conglomerate Zones

"The richer deposits of magnetite are so characteristically in the granule and conglomerate zones that we are led to believe that the primary leaching was a determining factor in the development of the richer magnetites from the lean ferruginous cherts, greenalite, etc. . . . Deep burial under slates developed heat and pressure that recrystallized a great deal of the formation. The iron minerals reacted at this time with each other and with organic matter, and possibly with other reducing or oxidizing agents producing magnetic oxides of iron. The recrystallization produced shrinkage cracks, and some regional movements developed

showing the virtual absence of overburden on the deposit

folds, but these seem to have no important effects on the formation. Contact action by the Duluth gabbro intrusions and sills made a great difference in the texture of the deposits at the east end. Erosion has exposed the metamorphosed beds without very important weathering effects on the mineral."

These views are not concurred in by all geologists, but they give one account of the origin of the ore that seems to be reasonable.

The principal constituents of the magnetic taconite are quartz, amphibole, and magnetite. It is in fact remarkable that the deposits contain so inconsiderable a proportion of other minerals. In the metamorphosed rock the quartz, the most abundant mineral, is found as quartzite, as crystals, and as fragmental grains. Amphibole was presumably formed from the metamorphism of miscellaneous clastic minerals in the primary deposit; it is now intergrown with the quartz and magnetite. The magnetite itself occurs in almost pure bands or layers varying from a fraction of an inch up to 6 or 8 in. thick, lying between layers of the magnetite-quartz-amphibole intergrowth. It also occurs as pebbles, small rounded granules, lenses, and in the prevailing intimate mixture of the three minerals.

Slight Dip of Strata

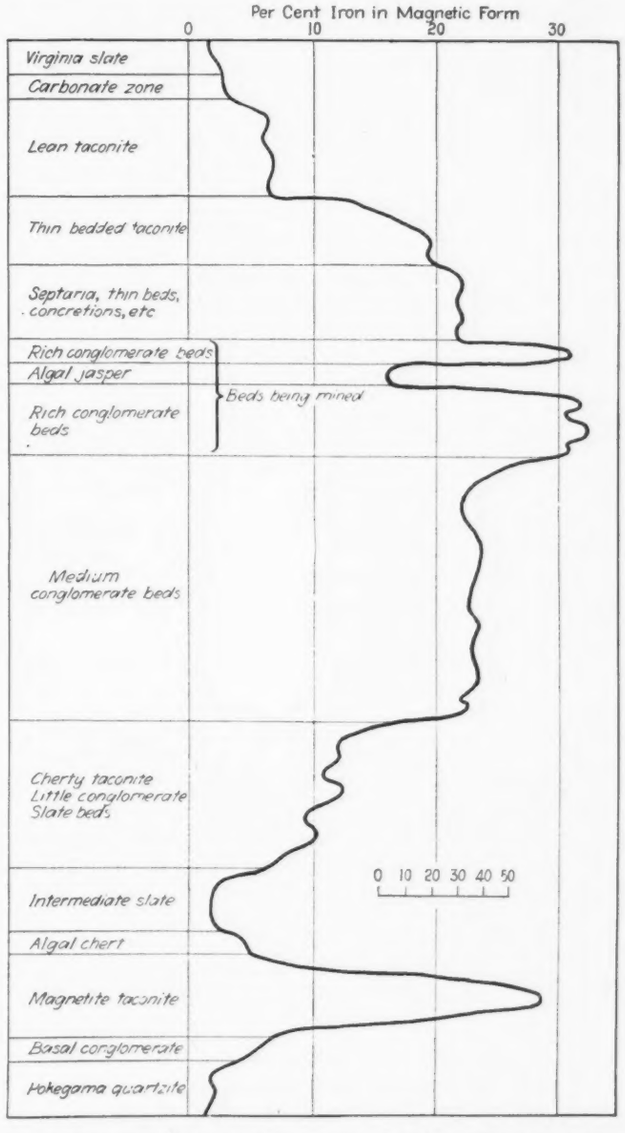
The accompanying generalized section taken from the report of Messrs. Grout and Broderick shows the stratigraphy as determined by diamond-drill cores. The horizon in which the Mesabi company is now working is the two rich conglomerate beds with the included bed of algal jaspar. It is apparent that the gentle dip of the strata makes the horizontal exposure of the richer strata broad and simplifies the mining or quarrying of the ore.

A typical analysis of the ore that is being mined by the Mesabi Iron Co. today is as follows:

Constituent	Per Cent	Constituent	Per Cent
Iron, total	33.80	Alumina	0.67
Iron, soluble	29.20	Lime	3.02
Iron, magnetic	28.00	Magnesium oxide	2.39
Silica	45.17	Carbon dioxide	0.58
Phosphorus	0.049	Sulphur	None
Titanium oxide	Trace	Manganese	0.61

It will be noted that the phosphorus content is comparatively low, a feature that is desirable because Bessemer "ore" which commands a premium in the market must be low in phosphorus. In this case it is not particularly significant, however, because phosphorus can be removed in the process of concentration, and it is the analysis of the finished product that is important.

The physical characteristics are of greater moment. (1) The fineness of the intimately mixed minerals adds to the difficulty of effecting a satisfactory metallurgical separation; (2) the exceptional hardness and toughness of the ore increases the cost of mining and milling *per cubic yard*, but (3) the unusually high density or specific gravity of the taconite tends to offset this disadvantage by making the costs much less *per ton* than

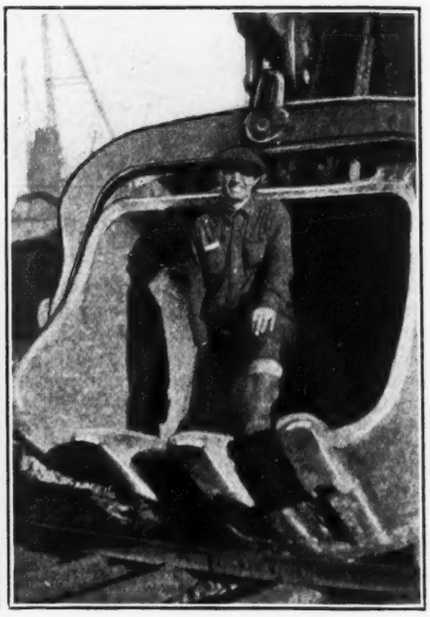


Typical geologic section of the deposit, showing the content of magnetic iron. The scale is in feet

they would be for an ore of equal hardness and toughness and lower specific gravity. If you break two cubes of rock having the same size and the same resistance to fracture based on toughness and hardness, the same amount of energy will be consumed. But if one rock is twice as dense as the other, only one-half as much work

Saddle-back locomotives are used exclusively

Loading taconite tests the sturdiness of the steam shovel

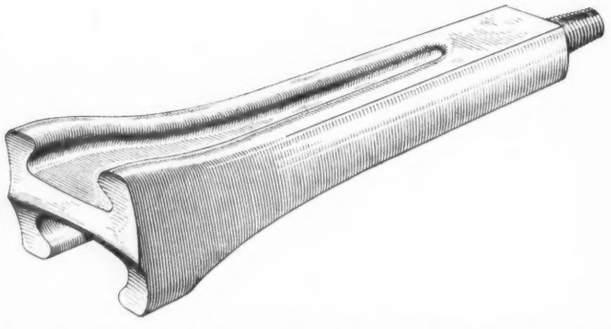


The business end of the shovel and the superintendent's assistant

per pound of product is required. This is an important point in considering the cost not only of quarrying but of crushing and grinding.

One of the Earliest Discoveries of Iron Ore in Minnesota

Probably the first prospecting of the eastern Mesabi was done by Peter Mitchell, of Ontonagan, Mich., in the spring of 1870. In that year he located several large tracts which are now included in the present holdings of the Mesabi Iron Co. The original Mesabi Iron Co. was organized in 1870, and in 1875 N. H. Winchell, then State Geologist of Minnesota, visited the



Sketch of the Gill churn-drill bit, the feature of which is its reaming edge

region and verified Mitchell's facts. This, I am told, was one of the first authenticated discoveries of iron ore in Minnesota. One of Mitchell's partners in this early enterprise died in 1876, and development of the land was abandoned, the property finally being purchased by George A. St. Clair, of Duluth, and his associates. It is generally known as the St. Clair-Williams land. Several geological examinations were made and some prospecting was done in an effort to find high-grade shipping ore, but the land was in the nature of a white elephant on their hands. Aside from the low grade, one great difficulty that looked to them insurmountable was the hard, tough character of the ore. They had tried to interest the big iron mining companies, but without success. "There is enough hematite to last for fifty years, and the next generation can solve its own problems," is probably the way the officials looked at the matter.

This was the situation in 1913 when the attention of Messrs. Hayden and Stone, through the late N. B. MacKelvie, was drawn to the property by D. E. Woodbridge, who, incidentally, did much of the subsequent preliminary field work and is still a consulting engineer for the Mesabi Iron Co. The proposition was referred to Mr. Jackling. The mere size of the thing fired his imagination. He saw an opportunity to turn to account vast natural resources. Here was a chance to pioneer.

Hayden, Stone & Co. Organized Syndicate in 1915

Mr. Jackling, early in 1915, delegated W. G. Swart, general manager of the company since the inception of the enterprise, and the late Horace V. Winchell to look over the proposition. Their report was non-committal as to the ultimate possibilities, but they were sufficiently impressed to recommend a painstaking investigation of all phases of the situation. Thereupon, a syndicate under the guidance of Hayden, Stone & Co. was formed to finance the investigation.

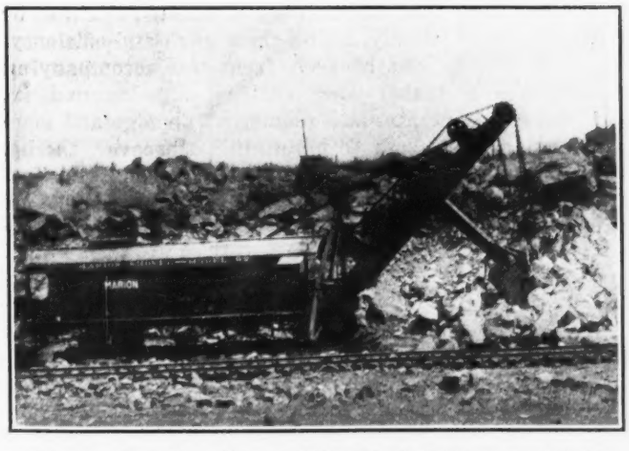
This work fell into three divisions: (1) The further prospecting and geologizing of the deposits, (2) the research to determine the best method of magnetic concentration, and (3) a study of the economic features including the probable cost of mining and "manufacturing" and the broader problems of the marketing of

the product. All of this work was entrusted to Mr. Swart, who, with a staff of engineers headed by Fred A. Jordan, made a survey of the entire country in search of information. For example, they visited and analyzed costs obtained in more than a dozen hard-rock quarries; they studied methods of sintering at a large number of plants and examined cost sheets; they investigated every phase of the market for the material they expected to make. No specific operation was contemplated that had not been done before; but never before had anyone combined the exact steps that were here necessary. Moreover, it was realized that the margin of profit at best would be small, and that a serious error in the estimation of any of the factors would be fatal.

First Large-scale Plant at Duluth

The first experimental work in ore dressing was done at the Minnesota School of Mines Experiment Station, where E. W. Davis, now superintendent of the station, had begun the development of a wet magnetic log washer for concentrating finely ground magnetite ore. Preliminary work was sufficiently promising to warrant the erection in 1916 of a plant of 100- to 150-ton capacity at Duluth. The operation of this plant furnished much information regarding the problems of crushing, grinding, concentrating, and sintering. Mr. Davis, who assisted in the work, improved his machine so that it did more efficient work. Results in 1917 were better than in 1916. During the following year a call came for low-phosphorus iron ore to be used in the manufacture of steel for armor plate. The plant at Duluth produced a cargo of sinter answering specifications so well that it brought $18 per ton when shipped to the plant of the Midvale Steel & Ordnance Co.

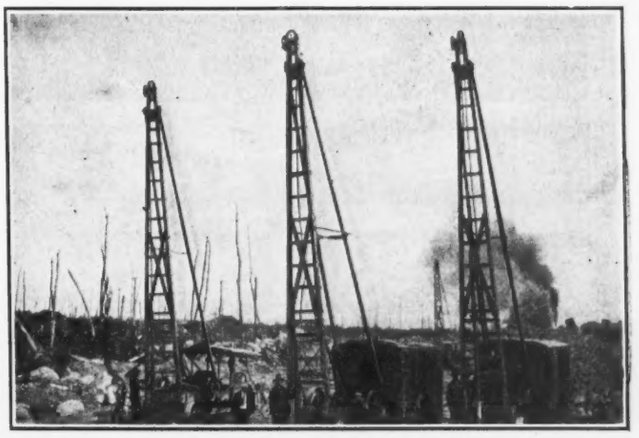
In the meantime, a thorough recheck of calculations was made, and, finally, the construction of a plant of commercial size on the range was recommended. In spite of the prevailing tightness of money the Mesabi Iron Co. was organized in 1919 with a capital of



Steam shovels, after a little block-holing, load into side-dump cars.

$3,000,000 to finance the work. The names on the directorate of the company are worth mentioning. They are: Charles Hayden, Daniel C. Jackling, John D. Ryan, W. E. Corey, Percy A. Rockefeller, C. M. McNeil, Sherwood Aldrich, W. Hinckle Smith, Alva C. Dinkey, Seeley W. Mudd, John R. Dillon, W. G. Swart, and J. Carson Agnew.

The first preliminary work was the development of a water supply for the plant and the building of a small town near the proposed site of operations. The town, christened Babbitt, is not to this day what might be called a prepossessing place. The country, as may be judged from the accompanying illustrations, is rather forbidding, and only the barest necessities in the way of offices and dwellings have been provided. Mr. Swart himself lives in a three-room cottage; and the combination town hall, movie house and church is little more than a shack. This will be all changed, however, when the ledger begins showing black instead of red, I am assured. In the meantime money will continue to go into the plant, where neither skimping nor extravagance can be observed.



Sanderson-Cyclone churn drills make 6-in. holes for blasting.

Early in 1920 construction on the power plant and concentrator proper was started, and in spite of long delays in 1921 the plant was ready to operate in June, 1922. The mine in the meantime had been prepared for production, and during July, 975 tons of sinter was made. As is usual, the first six months of operation revealed the need for some changes in the plant and equipment. Considerable delay was caused by defects in the design and construction of some of the equipment.

A nearer view of the cyclone drill.

Drill cores made in prospecting.

The various types of ore are indicated, including "disseminated," "banded," and "lenticular." The presence of comparatively clean quartz (white) shows why a discard can be cobbed from 2½-in. material

These have been remedied. Nevertheless, 20,864 tons of sinter averaging 63 per cent iron was prepared for the market during the last half of the year, and operations have been virtually continuous ever since, the output reaching about 300 tons of sinter per day. The coarse-crushing plant has a capacity of approximately 10,000 tons of ore per day; the roll or intermediate crushing plant is equipped to handle 2,500 tons, and the fine-grinding and separating department, as I said before, will soon be able to make sufficient concentrate to produce, 800 tons of sinter per day. The additions that will make this possible will be discussed in the article describing the milling and concentrating operations.

Mine Is Really a Quarry

I shall now outline the methods of mining and loading the rock for shipment to the mill, a distance of about two miles. The mine is in reality a quarry, this term being particularly descriptive because of the tendency of the rock to break in blocks often bounded by comparatively flat rectangular surfaces. This arises from breaking along joint and bedding planes, the presence of which characterizes all of the taconite. The stripping in the particular portion of the deposit where the work is now in progress was not a difficult matter, as much of it was practically free of overburden. An Erie steam shovel, Type B, with a ¾-yd. dipper, is used for stripping. Approximately twenty acres has been cleared, and the first cut in ore covers something less than half of this. On account of the newness of the work the faces are still low and short, and consequently quarrying is done under disadvantageous conditions.

The rock, as I have said, is hard and tough; for that reason, in spite of the high density, the cost of breaking is higher than in many quarries. Many holes are required; drilling them is slow and tedious work; and they must be loaded heavily. The following figures show the difference between the operations as carried out in starting the quarry and what is confidently expected will be accomplished when the faces are properly started:

	Past	Future
Spacing of holes, feet	15	20
Footage drilled, per ten-hour day	10	15
Depth of holes, feet	20	35
Tons broken per pound of dynamite	3	6

Sanderson-Cyclone churn drills, electrically operated, sink vertical holes, 6 in. in diameter, for blasting. For this hard rock it has been found very advantageous to use the Gill bit, a specially designed bit little used elsewhere on the Mesabi Range.

In very hard rock the corners of the usual chisel or cross bits wear rapidly, losing their gage and efficiency. The Gill bit, as can be seen from the accompanying sketch, has a rather long cutting edge around its periphery. It operates as a reamer. The edge and gage are comparatively easy to maintain. Moreover, the bit does not fitcher nor deflect along diagonal cracks: it drills a straight hole. A properly tempered bit of this design will drill from 6 in. to 2 ft. of hole before resharpening is required.

Sharpening Drill Bits Important Operation

William Mudge, superintendent of the mine, plans to install an oil-fired furnace for heating these bits, as this device can be regulated easily and is provided with a pyrometer to regulate the temperature. A satisfactory mechanical sharpener has been built, and the procedure and equipment for sharpening has been standardized. The idea is that any good workman can run the shop, and the efficiency of mine operations accordingly will not hinge, as it always has, upon a few "expert" blacksmiths, who are not entirely free from that weakness of all artists known as "temperament." As there are twelve Cyclone drills, it can be easily understood that efficient sharpening is vital to the success of the entire mine operation.

Holes which are sunk well below the horizontal plane to which it is desired to break range from 20 to 35

ft. in depth. They are loaded with 4x16-in. cartridges of 60 per cent gelatin dynamite and are tamped well with soft earth. Electric exploders or Cordeau-Bickford "fuse" are used to detonate the charge. The holes usually are fired in groups of from four to twelve, although several very large shots have been fired, 30,000 lb. of powder having been detonated on one occasion.

A limited amount of block-holing is necessary to reduce the pieces to steam-shovel size. For this 60 per cent nitroglycerine powder in 1¼-in. sticks is preferred. Ore is loaded with one of two shovels—a Marion, Model 92, and a Bucyrus No. 95—into 12-yd. steel, side-dump, air-operated cars. Of these, the company owns fifty, all supplied by the Western Wheeled Scraper Co. These cars are hauled over standard-gage tracks by means of six-wheeled seventy-six-ton locomotives of the saddle-back type. There are two of these.

A feature is the use of the Vanderhoff front on the dippers of both steam shovels. The wear on the teeth is severe, and the Vanderhoff construction permits of rapid replacement when occasion arises.

Factors for and Against Low Costs

Three factors tend toward economical mining at Babbitt: First, the absence of any considerable overburden; second, the great size and the comparative uniformity of the deposit—that is, the absence of horses or layers of waste material that must be mined separately and discarded; and third, the high specific gravity of the rock, which may be called an "advantage" when relative per-ton costs are considered. The one big disadvantage is the hardness of the rock.

In concluding this article, I desire to sum up briefly the economic phases of the enterprise:

1. In the first place, I must explain my allusion to to a source of income apart from the sinter marketed. In the process of concentration it has been found profitable to separate at various stages of treatment certain lower-grade portions of the rock, rather than run the material through the subsequent crushing, grinding, and concentrating processes. In the aggregate this has amounted to about one-third of the ore delivered to the mill. Though this discard contains about 10 per cent magnetic iron, it is cheaper to mine new ore than mill this low-grade material. The line of demarcation, of course, varies with the fluctuation of costs and selling prices, but ranges between 8 and 12 per cent. Another factor is the greater ease with which a high-grade concentrate can be made from the lenticular and banded magnetite type of ore than from the finely disseminated type. This will be mentioned in the second article.

The byproduct, a hard, clean, crushed stone, has found a ready market in sizes ranging from 2½ in. down to 6 mesh. It is suitable for use as a concrete aggregate, for paving, ballast, road dressing, and other purposes for which crushed stone is used. The sale of this product has been a source of considerable income for the company, although no account was taken of it in the original calculations.

High-Grade Sinter Has Ready Market

2. The market for magnetite sinter is firmly established. The company is easily able to make a Bessemer sinter containing 65 per cent iron. The product is uniform in grade and in physical condition. It is in demand as a sweetener for mixing with lower-grade ores to bring up the average tenor of the blast-furnace charge. The Ford company, for instance, has contracted for a large part of the Mesabi's company's output to mix with a low-grade limonite that comes from the Ford mines in Michigan. Concerning the sinter produced Mr. Swart says: "It is clean, porous, dry, and fairly free from fines. It assays 63 to 65 per cent iron, 8 to 10 per cent silica, a little manganese, lime, and magnesia, and from 0.025 to 0.032 per cent phosphorus. It contains no sulphur and but a trace of titanium. The 'dry' and 'natural' iron are the same, since there is no moisture when loaded into the cars. The sintering process changes some of the magnetite into hematite, so that sinter is really a mixture of the two. It is readily reducible and seems to act as a good 'medicine' for the blast furnace." Obviously, sinter enjoys some advantage over natural shipping ore in the matter of freight charges, as a consequence of the low silica content and the virtual absence of water. Moreover, a smaller quantity of fuel and flux is required per ton either of pig iron or of steel produced.

The standard market price for Lake Superior iron ore was 50c. per ton higher in 1923 than in 1922, and the demand is strong. It is probable that by 1930 the peak of production of direct shipping ore will have been reached and that a steady decline may be expected after that. It is unlikely that any considerable deposits of iron ore tributary to the steel furnaces west of the Appalachians will be discovered, so that Mesabi sinter

"Business" section of the town of Babbitt.

seems destined to supply a fair share of the raw material for the American iron and steel industry. That some revolutionary process may be developed to change the situation is possible, but this is, to say the least, highly improbable.

3. The question of ore reserves is in reality no problem at all. The company controls by ownership and lease 16,000 acres of land, about half of which consists of taconite. The Minnesota Geological Survey has calculated roughly 1,500,000,000 tons of taconite within 100 ft. of the present surface. Of course, not all of this is as high grade as the material now being mined. Only a small portion has been drilled, but the fact that the strata are so uniform and the outcrops so numerous makes a geological estimation unusually dependable. However, enough drilling has been done to prove an adequate reserve of ore of the present grade to supply the plant at its increased capacity for several years, and more development now would be a waste of money. The terms of the leases provide a royalty based on net income only. Calculated on the highest estimated profit, this royalty is considerably below the usual royalties of $0.50 to $1 per ton prevailing elsewhere on the Mesabi Range.

4. The original estimates on which was based the decision to build the plant at Babbitt called for a production of not less than 800 tons of sinter per day to insure profitable operation. As in the case of the low-grade copper enterprises, the large scale of operations was an essential element in the solution of the problem. A large production is necessary to permit the thin spreading of overhead costs. Mr. Jackling declares that there is no phase of the undertaking in which experience has not proved that the original estimates were amply conservative. To increase the capacity of the plant to 5,000 tons of ore, or 1,700 tons of sinter, per day will require no duplication of such adjuncts as town site, water-supply system, tailings-disposal system, and coarse-crushing plant and equipment. Numerous fixed costs and many elements of the operating costs will be little greater on a 5,000-ton basis than on the basis of 2,500 tons. Various mechanical and technical difficulties have been experienced since the plant started. This was to be expected. However, as I shall show in the subsequent article describing the concentrator, means have been found to overcome these troubles. Comparatively clear sailing seems to be ahead.

To be concluded

Treatment of Flotation Concentrate with Strong Cyanide Solutions

By Paul T. Bruhl and Fred C. Bond

WHILE experiments were being conducted to determine the best method of adding low-grade cyanide to a mill pulp it was considered possible that when the addition was made to the pulp in the solid form a temporary reprecipitation of some of the silver already in solution might occur, owing to the presence of soluble sulphides. A sample was taken from the thickener underflow and 20 lb. of cyanide was then added to the pulp, which was sampled further down the launder leading to the agitators. It was expected that the second solution sample would assay less in silver than that of the first; such, however, was by no means true, the solution of the second sample assaying considerably higher in every instance and indicating an unusually high and rapid silver extraction from the solids. In fact, this strong solution effected as good an extraction in less than a minute as the much weaker solution in use effects in many hours.

We have been interested in the cyanidation of complex argentiferous and auriferous flotation concentrate, and the idea occurred to us to try the effect of strong cyanide solutions on such a concentrate. The cyanide strength was varied between 0.5 and 5.25 per cent sodium cyanide. The extraction varied between 32 and 96 per cent of the silver. The best gold extraction was 95 per cent. The cyanide consumption was between 40 and 60 lb. equivalent pure potassium cyanide; the lime consumption was between 5 and 10 lb. (100 per cent water soluble) per ton of concentrate. Experiments were made with both 96@98 per cent cyanide and Aero brand, and similar results were obtained with both grades. All solutions were freshly made up.

We give this data because the field appears a fertile one for investigation, especially for flotation mills which have to meet heavy freight and treatment charges.

The table that is here presented shows typical results:

Experiment No.	Dilution L : S	KCN Per Cent	Agitation, Hours	100 Per Cent KCN Consumption per Ton of Concentrate, Pounds	100 Per Cent Lime Consumption per Ton of Concentrate, Pounds	Per Cent Extraction, Ag	Au
1	8 : 1	0.505	24	19.2	Not determined	32.9	
2	8 : 1	1.344	24	20.0	Not determined	36.8	....
3	8 : 1	2.625	24	29.9	Not determined	48.9	....
4	10 : 1	3.188	24	50.0	Not determined	46.3	....
5	8 : 1	3.875	24	40.0	Not determined	58.2	....
6	4 : 1	6.560	24	69.6	Not determined	93.8	....
7	8 : 1	6.250	4	60.0	6.4	92.4	....
8	10 : 1	6.750	6	43.8	Not determined	95.9	95.2

An incomplete analysis of the concentrate shows: Ag, 380 oz.; Au, 1.55 oz.; Pb, 3.1 per cent; Cu, 0.7; Zn, 3.5; Fe, 22.8; Mn, 0.9; S, 28.1, and "insoluble," 34.8 per cent.

Oil Prospecting in Queensland

The up-to-date rotary drilling plant imported from California by the Lander Oil Field, Ltd., was formally started by the Minister for Mines at Orallo, near Roma, Queensland, on Nov. 21, and drilling is now in full swing. Duncan Milsom is in charge and has three expert drillers as assistants, whom he brought out with him from Los Angeles. At the starting function, the company was represented, in addition to Mr. Milsom, managing director, by A. E. Laurence, chairman of directors, and two other directors of the Lander Company (James Burns and Mr. Grace), all of Sydney, New South Wales.

The Lander company is working under a special agreement with the Queensland Government, which has granted it a concession over an area of 1,000 acres, instead of only 360 acres, provided for by the act of Parliament in force when the agreement was signed last year. This act, however, has since been amended, and under the new statute the six original members of the company can each obtain 2,000 acres in the event of oil being discovered.

Dust Control in Crushing Plants Important

Unhealthful Working Conditions Need No Longer Be Tolerated—
How They Can Be Remedied

By George E. Lynch
Consulting Mechanical Engineer, Los Angeles

THE CONTROL OF DUST in mills and crushing plants is a paying investment. It invariably increases the efficiency of men and machines and reduces labor turnover. Nearly always it conserves, and returns to the mill, valuable material which is otherwise lost, the saving thus made usually amounting to much more than its operating cost. In many states the elimination of dust hazards is compelled by law, and it is probable that the time is not far distant when such regulations will be applied everywhere, for the benefits to be derived are many, for both the employer and employee.

In ore-reduction plants, the extent of the loss of valuable mineral is usually not quantitatively known, although that there is a material loss is strongly suspected by most millmen. It is true that much dust, settling on floors and machines, is swept up and returned, more or less intermittently, to the mill flow, but even in the most carefully kept plants this represents less than half of the dust which might be saved and returned by any reasonably efficient dust-control system. Tests show that this fine material usually runs considerably higher in metal content than the heads, and, even in plants producing only crushed rock for the building trade, the dust, if properly collected, would find a ready market for asphalt facing.

Of course, conditions may be imagined, as in a small plant or one crushing wet ore only, where the amount of dust escaping is too small to justify the installation of a control system. But in any large plant the presence of floating dust is an evidence of incompetence or of indifference on the part of the designer and the management. The cost of installation and operation of a suitable dust-control system is so small, and the principles of successful design are so well understood, that there is no excuse whatever for expecting men or machines to work in a dust-laden atmosphere. No large plant should be built without adequate provision for the control of dust being incorporated in the original designs.

What Constitutes "Dust"?

Dust may be regarded as any finely divided dry material sufficiently light to be transported by air currents. In the handling of ores, this approximate definition would cover practically all minus 200-mesh fines, carrying less than 7 per cent moisture, and, in many cases, particles much larger than these, according to the specific gravity and physical properties of the ore. Some material of this nature is an invariable result of any crushing or grinding process in which rock is reduced to smaller sizes, whether for use direct as concrete aggregate, or for feed to other grinding or pulverizing machines which produce sizes suitable for concentration or flotation.

In many manufacturing processes, such as buffing and grinding metal parts, woodworking, and the handling of cotton, fine or light material is necessarily made as a byproduct. For continued and efficient operation of the machines, this material must be collected and transported to some convenient point for disposal, and it has been found that a suction system of some form is the most suitable. Since, however, such manufacturing processes rarely require the provision of conveyors or other carriers, and the actual desired product has no definite relation to this dust, it is necessary that the collection system be able also to dispose of it. Such an installation should properly be called a "Dust-collecting System."

The "Dust-control System"

The crushing of rock differs considerably from these manufacturing processes. Here, the dust, unavoidably produced, varies from the main product only in being more finely divided. It is a normal part of the mill product, and, as such, should be carried, so far as possible, by the means provided in the mill design. Further, the amount of potential dust in a crushing plant is so much greater than in any manufacturing process that it is inadvisable to make any attempt to collect all of it, even if such complete collection were practicable. The object here should be to confine all the mill product, fine and coarse, to the channels already provided in the flow sheet, collecting only the small part unavoidably drawn into the pipes and leaving the larger part mechanically trapped by the coarser portion of the mill flow. Such a system may best be defined as a "Dust-control System." Many efforts to mitigate a dust evil fail by attempting to make a dust-collecting system rather than one of dust control. Others encounter trouble by regarding the problem as similar to one involving smoke or fumes.

It should be apparent to anyone familiar with crushing work that any attempt to collect all the possible dust, or even to catch a large percentage of it, must be economically a failure, since though it might be possible, by large classification and transportation units, to separate this part of the product from the mill flow and, neglecting the mechanical conveying system, carry it away in the suction pipes, the results would not justify the cost of installation and operation. Equally, to the observing engineer, the striking differences in behavior of smoke and of dust should furnish a warning against trying to pull the dust upward into hoods or pipes.

Air Currents Must Be Studied

Dust, from its nature, is necessarily heavier than air, and can move only by mechanical impulse or by the action of air currents. An uprising cloud of dust means always an equally uprising but invisible body of air. Leakage and escape of dust about a machine indicates the movement of uncontrolled air currents, rendered visible by their dust content. If, then, the air currents in and about a machine are controlled and directed, the dust must, equally, be controlled and directed, and by proper design the escaping dust may be entirely eliminated, assuming, of course, that mechanical splashes and spills are safeguarded.

The design of a dust-control system, then, involves as

a preliminary, the study of the uncontrolled air currents, especially as to their origin and volume and speed. The engineer experienced in dust work can readily approximate what these currents will be from the drawings of a proposed mill, and estimate the sizes of pipes and the volumes of air needed to control them. From this study, an estimate of the required suction plant capacity can readily be made. Given the diameters of pipes for the various machines, with their proper air speeds and volumes, it is a simple matter to combine the areas and arrive at the size of fan needed. The respective speeds and volumes of air, with the friction allowance for the system, determine the extent of the vacuum and the horsepower and number of revolutions of the fan. This covers about one half of the work of design, the other and more difficult part being the placing of pipes and openings and the adjustment and balancing of the air currents after the plant is installed. The pipes and headers must be located so that all usual repairs and replacements on machines can be made with the minimum of interference, that cranes and travelers be not obstructed, and that the men must have absolute freedom to watch the process of crushing at all important points without having to open doors or covers.

Next in importance is the location of the suction openings at the various points of connection. Bearing in mind that the system is one of control, rather than collection, these openings should be placed so that, while retaining the dust so far as possible in the chutes and inclosures provided, they actually collect and carry away the minimum quantity of solids. It is comparatively easy to collect large amounts of dust in the pipes, but the problem of disposal of this large quantity of dust, with the accompanying air volumes, is exceedingly difficult. An ideal plant would be one that, while keeping the air about the machines free from floating dust, carried no solids in the pipes, but simply clean air.

Ventilation Not a Determining Factor

An excessive volume or speed of air at any machine tends to defeat the object of the installation, not only drawing heavy materials into the pipes and causing stoppage at every bend, but also setting up unexpected swirls and eddies in the machines and chutes, which cause blowouts and leaks. The increased ventilating effect of excessive volumes of air is not important. Even with the minimum amount of air handled in a system, the ventilating effect is very noticeable and, for cold countries, is entirely sufficient during times when the mill must be kept closed. In hot climates, ventilation through doors and windows is effective and considerably cheaper than mechanical ventilation, so that it is best to confine the efforts of the system to dust control alone and be properly appreciative of the improved air conditions accompanying it.

The piping system should be as short and direct as possible. If the plant is large and requires extremely long lines, it is usually best to design the dust control in several units, thus keeping down the lengths and diameters of pipes to an economical basis. Long headers should be given a slope, when practicable, in the direction of flow, but this is not imperative, since, with proper design and proportioning of air volume and speed, a horizontal pipe will function just as freely and efficiently as a sloping one. The engineer has, therefore, a wide latitude in his work and there is rarely any occasion to place a pipe where it will interfere with easy access to the machine or require taking down during ordinary repairs or replacements. The use of hoods over machines is rarely necessary, and such installations should be avoided even at some sacrifice of efficiency. Hoods and covers must be removed when repairs are made, and, although they may be replaced a few times when the plant is a novelty, the final result is that they are left off permanently and the dust control at this point is neglected.

Changes Indicated by Practical Operation Should Not Be Disregarded

After the piping, fans, and collectors are installed and the crushing plant is in operation, the final adjustment and balancing of air currents must be made. This is highly important, and the care used at this time determines the success or failure of the installation. Some of the pipes will persist in drawing their air from the wrong direction, thus causing an excessive movement at one point and none at all at some other and equally necessary point. Others will develop a tendency to stop up at some angle or level. Heavy vertical drops of ore in chutes or at discharges will carry down large volumes of dust-laden air beyond the capacity of the suction pipes. The remedy for each of these conditions must be studied out and applied, whether it be the introduction of friction to reverse an air current, the increase of speed and volume to eliminate stoppage, or the readjustment of the chutes to reduce the speed and air-carrying capacity of an ore flow. All unnecessary openings must be closed so as to concentrate the air flow at the necessary openings. Leaks and spills must be stopped, and provision made for catching the dust carried over on conveyor belts and shed by the idler pulleys. At this time, also, the speed of the fan should be adjusted to the most economical point and the motor size changed so as to run it at close to full load and thus help on the power factor of the plant.

Having designed and adjusted the plant to use the lowest power consumption and air volume that will give satisfactory results, and placing the openings where they will draw into the system the minimum quantity of solids, the problem of disposal is reduced to its lowest terms. I have always preferred to throw down the greater part of the collected dust in an ordinary conical or cyclone collector, returning the product to the mill flow by gravity at the most convenient point. The exceedingly fine dust escaping from the collector may be dropped either in a baghouse or a spray tank. The latter is preferable, as it is easier to install and to operate than a baghouse and costs considerably less for the same capacity. A good spray tank will catch about 98 per cent of the dust blown into it and should require only water enough to enable it to deliver the collected dust in a pulp carrying about 18 to 20 per cent solids. Under most circumstances, the dry cone will drop 75 to 80 per cent of the collected dust. If desired, the small flow from the spray tank may be incorporated with this, and, being discharged on the main conveyor, the contained moisture is quickly absorbed and disappears in the crushed ore. Of course, a Cottrell system may be used, but, in my opinion, the expense of such an installation is not justified for a simple dust control, as the work may be done equally well by cheaper and simpler means.

When properly designed and installed, a dust-control system needs only a small amount of attention. Oiling of fan and motor bearings, starting and stopping, constitute the entire labor involved. Wear on the pipes

is slight, and, beyond the necessity of replacing an elbow or other part subject to abrasion, at extremely long intervals, the total upkeep is on the fan and motor and, with any standard type of machines, this is almost negligible. Naturally, valves and dampers in the lines are purposely omitted in the design, and no adjustment of any kind is introduced in the system if it can possibly be avoided.

A dust-control system was recently completed at the new Phelps Dodge mill near Warren, Ariz., in which the arrangement and size of the crushing plant necessitated the use of two exactly similar units, each consisting of a No. 80 Sturtevant Exhauster and its motor, with a dry collector and a spray tank for each unit. Main header pipes were run on the outside of the building to avoid obstructing the cranes. Connections to the machines were made by short pipes with a minimum of turns and elbows. Ordinarily slip-joint pipe made of galvanized steel was used, the largest headers being 30 in. in diameter, made of No. 16 steel.

The greater part of the collected dust is eliminated in the dry collectors, the very light material which escapes from the cones being caught in the spray tanks. These tanks, made of light, galvanized plate, were set on concrete bases with sloping bottoms and weir boxes of concrete to maintain the required water seal. The concrete was carried up about a foot above the water level, as the deposited dust, with its contained water, is very acid and would rapidly corrode the thin sheet of the tank if left in constant contact. The water sprays, flowing down the sides of the tank, are continually renewed by fresh water, so that they do not become acid enough to cause corrosion.

On fairly dry concentrating ore, the system collected from eight to ten tons per shift. This dust was exceedingly fine, showing about 1 per cent on a 65-mesh screen and 92 to 94 per cent passing 200 mesh. The copper content was variable, but averaged about twice that of the heads. Of this dust, perhaps 80 per cent was dropped in the dry cones, most of the remainder being caught in the spray tanks. These proved very efficient, using only about ten gallons of water per minute each, and showing only a small mist of dust and water vapor at the top discharge pipes. The plant works under a suction of 3½ in. water, the friction of piping and collectors being low.

In crushing dry oxidized ore from the stockpile (approximately 1 per cent water and 2 per cent of minus 200-mesh material), about double the above amount of dust was collected, the copper content running about the same as the heads. The fineness was the same as in the case of concentrating ore. This feature is important as showing that the speeds and volumes of air at the suction openings were correctly calculated and that heavy material was not being drawn into the system.

This plant gave entirely satisfactory working conditions in the crushing department. Previous to the installation of dust control, the men were obliged to wear respirators continually, and the deposit of dust on the main floor of the mill about the final crushers frequently amounted to three or four inches in depth in one shift. In the tunnels under these crushers the conditions were absolutely intolerable. Men could not work here, even with respirators, and the dust was usually knee deep on the floors, despite frequent cleaning.

In another plant at Nacozari, Sonora, of about half the capacity of the one just described, but handling sulphide ore from underground workings, the dust returned to the mill was estimated at three tons per shift. The fineness was practically the same as in the other mill, but the copper content was somewhat more than twice that of the heads. Control was simplified here by the fact that the fines contained in the incoming ore were damp and the greater part of the free dust was produced by the breaking of the rock. In both cases described, the values of the mineral returned to the mill were estimated to be considerably in excess of the total operating costs of the control systems, and thus the Phelps Dodge company has not only greatly improved conditions for its workers, but at the same time has real money-saving installations.

Conditions as described above will apply to any crushing process in which the ore is fairly dry and the reduction proceeds to 1¼ in. or smaller before water is added. The dust-control system not only creates better conditions in the plant, reducing labor turnover and repair bills, but also usually pays more than its cost of upkeep in ore returned to the flow. It is rarely necessary that the plant be able absolutely to eliminate all dust in the mill. Most operators and their men are satisfied if working conditions are agreeable and not unhealthful, and crusher men do not, as a rule, wear white collars at their work. However, the securing of good clean conditions is practically as simple and costs no more than is required for a halfway job, so that the engineer should aim for complete elimination of all dust within practical limits.

It is not intended to convey by the foregoing that the handling of dust is a simple matter or one that should be attempted without careful study. No two plants are alike in their requirements, and the system which gives satisfactory results in one place may be entirely too small in another plant handling the same tonnage of ore. A crusher or pair of rolls may, in one instance, be kept entirely clear with a 6-in. pipe, whereas a similar machine under other conditions may require one of 12-in. or four times the capacity to produce the same effect. Unfortunately, in most cases, the dust-control system is an afterthought and must be designed to fit a plant already in operation. The work may thus be compared to that of installing a system of drains and pipes for sewage in an old house.

If the dust problem could be given proper consideration in the original design of a mill, its efficiency could be increased and the cost appreciably lowered. There is no reason why the main headers and a large part of the piping could not be replaced by concrete ducts in the machine foundations, with very short pipes connecting with the sources of dust. Proper design would eliminate possibility of stoppage, and no replacement for wear would ever be necessary.

Sweden's Wealth in Iron Ore

During the last few years the iron-ore deposits in the Kirunavaara Mountains and in the district of Malmberg (ore mountain), in the north of Sweden, have been carefully examined by a special state commission with a view to determine their richness. This commission has now published a report, from which it is gathered that the veins are much thicker and much more extensive than had hitherto been assumed. It is stated that the deposits of the Kirunavaara district especially, which in 1913 were said to contain about 740,000,000 tons, are much richer. The grade of ore continues good with depth.

Has the Miami-Picher District Passed the Zenith?

An Analytical Study of the Question

By Karl L. Koelker
Consulting Mining Engineer, Joplin, Mo.

THIS PRESENTATION of facts relative to the productivity of the Miami-Picher zinc-lead district is based upon the following information:

1. Production records published by the U. S. Geological Survey.

2. A composite map of the Miami-Picher district compiled by me from the surveys of the different mining companies. The gathering of these maps was made possible through the Tri-State Chapter of the American Mining Congress.

The area inclosed within the dark area has been assumed to be "proven" mineralized area. The dark-colored area has been assumed to be "possible" mineralized area. Numerous good drill samples have been obtained in the exploration of this possible mineralized area, but they are not of as high a grade as the average in the outlined area. One might say that the dark area is an extension of the known field.

The following table gives the production statistics of the Miami-Picher district. This table shows that from 1917-1922, approximately 37,500,000 tons of rock has been mined, producing 471,601 tons of lead and 2,176,307 tons of zinc concentrate. The "recovery" of lead averaged 1.26 per cent and the recovery of zinc averaged 5.81 per cent, making a total average recovery of 7.07 per cent.

Production Miami-Picher District to Jan. 1, 1923

Year	Lead, Tons	Zinc, Tons	Lead Recovery, %	Zinc Recovery, %	Total Recovery, %	Rock, Tons	Zinc, Average Yearly Price	Lead, Average Yearly Price
Oklahoma								
1917	27,999	150,335	0.90	4.86	5.76	3,100,000	$67.44	$100.77
1918	69,693	298,749	1.22	5.23	6.45	5,712,279	50.55	88.54
1919	67,670	336,403	1.13	5.47	6.60	6,122,318	43.00	67.87
1920	81,413	405,868	1.18	5.87	7.05	6,911,787	44.96	93.93
1921	52,234	225,506	1.76	7.60	9.36	2,967,307	22.83	53.48
1922	79,458	389,280	1.29	6.32	7.61	6,159,500	34.37	75.12
Total	378,467	1,806,141	1.22	5.83	7.05	30,973,191		
Kansas								
1917	1,005	12,070	1.10	6.90	8.00	163,437	$68.96	$93.91
1918	7,625	40,473	1.10	5.67	6.77	710,457	52.48	90.90
1919	13,522	76,470	1.01	6.32	7.33	1,227,721	44.35	68.27
1920	19,831	94,565	1.22	6.63	7.85	1,457,273	45.36	96.27
1921	22,346	52,762	2.00	6.05	8.05	933,018	23.16	53.79
1922	28,805	93,826	1.49	4.83	6.32	1,939,400	33.60	78.56
	93,134	370,166	1.45	5.75	7.20	6,431,306		
Totals	471,601	2,176,307	1.26	5.81	7.07	37,404,497	$43.35	$79.55

Production of Lead and Zinc

	Concentrate, Tons	Rock, Tons
1917	191,409	3,263,437
1918	416,540	6,422,736
1919	494,065	7,350,039
1920	601,677	8,369,060
1921	352,848	3,900,325
1922	591,369	8,098,900
	2,647,908	37,404,497

Estimated Production for Year 1923

The production of concentrates in dry tons for the year 1923 is estimated as 81,700 tons of lead and 584,000 tons of zinc.

Zinc

	Tons
Production first 41 weeks of 1923	490,000
Production remaining 8 weeks 1923 8 × 13,500	108,000
Production 3 weeks during curtailment 3 × 3,500	10,500
	608,500
Deduct 4 per cent moisture	24,500
Production dry weight	584,000

Lead

Production first 41 weeks of 1923	69,000
Production remaining 8 weeks 1923 8 × 1,700	13,600
Production 3 weeks during curtailment 3 × 400	1,200
	83,800
Deduct 2½ per cent moisture	2,100
Production dry weight	81,700
Estimated total production during 1923	665,700
Estimated price 1923 to date	
Zinc concentrates	$41
Lead concentrates	94

With the above estimate of production for the year 1923, the total of the production for the Miami-Picher district to Jan. 1, 1924, will be approximately 553,000 tons of lead concentrates and approximately 2,760,000 tons of zinc concentrates, or a total production of both of approximately 3,300,000 tons.

Area Mined in the Miami Picher District

The district map is an accurate pantographed reproduction of the individual mine maps of the different companies. All of these areas mined were measured with a planimeter with the following results:

Years 1917-1922—The total area mined was approximately 660 acres, of which 24,218,800 sq.ft. was mined in Oklahoma, and 4,460,400 sq.ft. was mined in Kansas.

Year 1923—The total production estimated is 665,700 tons of concentrate. The estimated production per acre mined is 4,002 tons of concentrate. (This is estimated in the next paragraph.) Therefore, the total area mined during 1923 is approximately 170 acres.

Estimated Production of Concentrates per Acre Mined

With the area mined and the production known, the production per acre of mined area is as follows:

Oklahoma

Tons zinc concentrates per acre	3,242
Tons lead concentrates per acre	679
	3,921

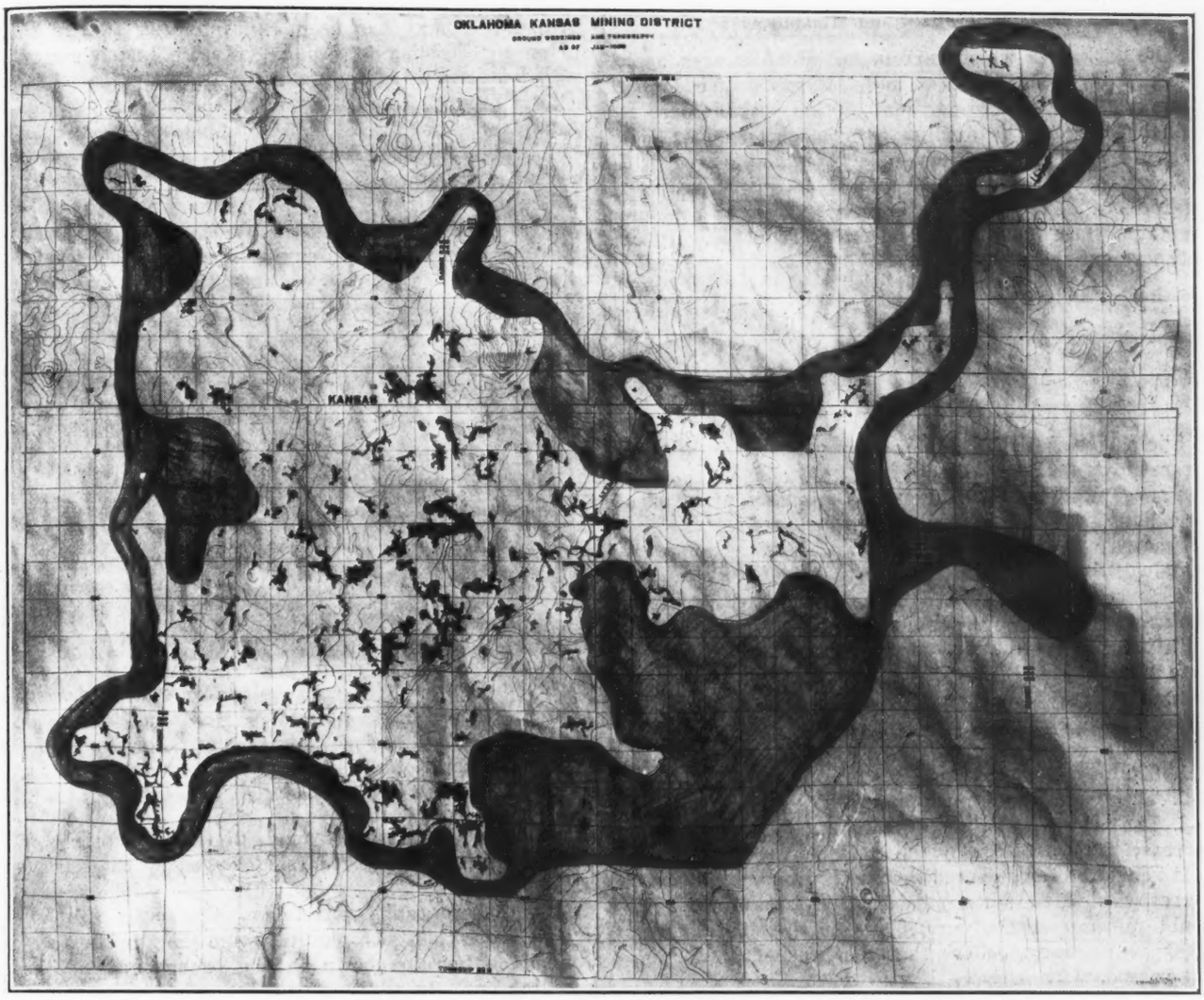
Kansas

Tons zinc concentrates per acre	3,526
Tons lead concentrates per acre	905
	4,431

Average Oklahoma and Kansas

Tons zinc concentrates per acre	3,287
Tons lead concentrates per acre	715
	4,002

You will note that the production per acre is higher in Kansas than Oklahoma. This is due to the higher face of ore in Kansas, as outlined in the next paragraph.



Composite map of Picher district, showing proven and potential mining area

Estimated Height of Orebodies

With all factors known except the height of the orebody, the results obtained were as follows:

Estimated Height of Orebody in Oklahoma

Area in ore, sq.ft.	24,218,800
Average thickness, ft.	15.98
Cubic contents, cu.ft.	387,164,887
Tons rock @ 12.5 cu.ft. per ton,	30,973,191

Estimated Height of Orebody in Kansas

Area in ore, sq.ft.	4,460,400
Average thickness, ft.	18.02
Cubic contents, cu.ft.	80,391,325
Tons rock @ 12.5 cu.ft. per ton,	6,431,306

Average Height of Face Oklahoma and Kansas

Area in ore, sq.ft.	28,679,200
Average thickness calculated, ft.	16.3
Cubic contents, cu.ft.	467,556,212
Tons rock mined	37,404,497

Known Exhausted Mines or Mines Whose Drilling Show No Reserves

Thirty mines of the district were averaged relative to the area mined, and showed that 248.22 acres were mined, or an average of 8.2 acres per 40-acre tract. This is equal to 20 per cent minable of the mineralized area.

Proven Mineralized and Minable Area

The white area inclosed by the dark area is assumed to be mineralized ground. From the record of these thirty mines, only 20 per cent of the mineralized ground is minable. Following is an estimate of the reserve of minable mineralized area as of Jan. 1, 1924:

	Acres
Proven mineralized area	8,000
Assume 20 per cent mineralized	1,600
Area mined as of Jan. 1, 1923	(6)
Mineralized area remaining unmined	940
Estimated area mined during 1923	170
Remaining area minable as of Jan. 1, 1924	770

Assuming an average height of face of 16.3 ft. and 12.5 cu.ft. per ton of rock, there are approximately 44,000,000 tons of rock in reserve.

What is the estimated recovery of this reserve? Due to conditions which have existed in the industry for the last few years, many of the properties have been robbed of their high-grade orebodies. With a past record of approximately 7 per cent recovery, it is believed that the future recovery of this reserve will not exceed 6 per cent. It is believed that the future will see a greater ratio of zinc to lead than the past. Assuming a future recovery of 6 per cent, the following estimation results:

774 acres = in sq.ft.	33,715,440
Average height of face, ft.	16.3
Cubic contents, cu.ft.	549,561,672
Tons rock @ 12.5 cu.ft., per ton	43,964,934
Concentrate recovered @ 6 per cent, tons	2,637,900

Possible Mineralized and Minable Area

The dark area which surrounds the white area upon the map is assumed to be possible mineralized area. I assume that only 15 per cent of this possible area is minable. From the drilling that has been done, it is believed that the recovery of this minable area will not exceed 4.5 per cent. Assuming 13.5 cu.ft. per ton of rock (due to the lower recovery value), an average height of face of 16.3 ft., and an average recovery of 4.5 per cent there results:

Possible mineralized area, acres	6,000
Assume 15 per cent minable, acres	900
900 acres = in sq.ft.	39,204,000
Average thickness, ft.	16.3
Cubic contents, cu.ft.	639,025,200
Tons rock @ 13.5 cu.ft. per ton	47,335,200
Concentrates recovered @ 4.5 per cent, tons	2,130,084

Conclusions

Should the Miami-Picher district continue to deplete its estimated known reserve to supply 58 per cent of the consumption, it will take approximately four years to exhaust the area giving a 6 per cent recovery. The estimated weekly production during 1923 was approximately 12,800 tons of concentrates.

A forty-acre tract will produce approximately from the above estimate 30,000 tons of concentrates, so that, with the present output, one might say that a forty-acre tract of the 6 per cent reserve is being exhausted every two and one-half weeks.

To mine the "lower-recovery" ground in the Miami-Picher district three readjustments must be made:

1. The miner must reduce his mining cost.
2. The smelter man must reduce his smelting cost.
3. The price of zinc concentrates must increase, this increase to be paid for by the consumer.

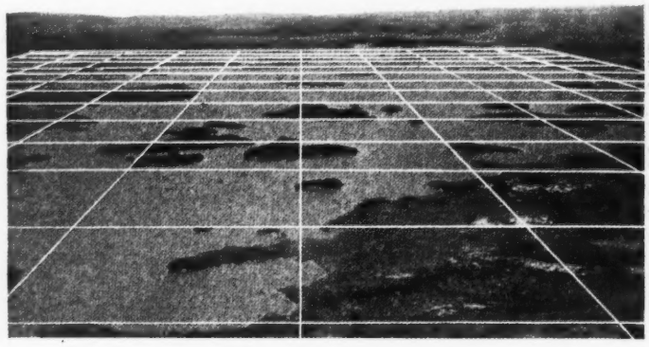
It should be remembered that with proper conditions, a great deal of the lower-grade rock can be mined. No doubt mining will be carried on in this district for many years, but I believe that the peak of production has passed.

Airplanes Used for Surveying Canadian Northwest

DURING 1923 experiments were carried out looking to the utilization of aircraft for supplementing the work of parties employed by the Canadian Topographical Survey in western and northwestern Canada, according to the Canadian Department of the Interior. These experiments were conducted by the Royal Air Force of Canada under the direction of A. M. Narraway, Controller of Surveys, and consisted of the taking of series of vertical and oblique photographs from aircraft flying at predetermined heights, and the use of these photographs as an aid in the plotting of topographical features on the map.

Operations were first conducted in the area north of The Pas, Manitoba, where reliable maps are needed to facilitate the development of the mineral and forest resources in which the district is known to abound. Here countless islands are separated by rocky ridges covered with almost impenetrable bush. Owing to the mass of detail required and the great difficulties to be overcome in collecting it, the production of an adequate map of such a country by ordinary survey methods is very expensive, and as a result the collection of topographical information has heretofore been restricted to the limits of the main connected waterways.

A survey party had been sent into this area in the spring to establish a through traverse line along the main waterways extending from Athapapaskow Lake to the Churchill River, as well as throughout the mineralized area to the east. In anticipation of the aerial photographic work to be undertaken, the party was instructed to note carefully the stations occupied so as to be able to identify these points on the photographs. The party was followed later in the season by a seaplane carrying a pilot, an engineer, and a photographer with suitable emergency rations to provide against forced landings. The plane carried an aerial camera



The above picture of Sisipuk Lake, Churchill River, in the unexplored area in northern Manitoba, was taken from a seaplane and gives an idea of the aid of flying machines to the surveyor, prospector, and traveler. The photograph is gridded ready for plotting.

mounted over the nose and made flights at a height of about 4,000 ft. over the course followed by the survey party.

Oblique photographs were taken at intervals of about three miles so that each picture would show in the foreground the terrain shown in the background of the preceding one. In addition to these, other photographs were taken in a systematic manner at right angles to the line of flight. In this way photographs were obtained of a strip of country stretching for over five miles on each side of the line of traverse.

Subsequently when the photographs had been developed and collated a grid system was laid down on them based upon the points of the survey, and corresponding to a system of squares on a plan, thus enabling the various topographical features to be plotted. The illustration shows this system and also the general character of the terrain. Upwards of seven hundred views were obtained.

Radio Tower Exceeds Height of Tacoma Stack

The highest metallurgical stack in the world is at the American Smelting & Refining Co.'s smelter at Tacoma, Wash., 573 ft. high above the top of the foundation, being closely followed by one at Saganoseki, Japan, which is 570 ft. high. The Anaconda stack, which has the greatest capacity of any, is 555 ft. high. But the highest masonry structure in the world is the wireless tower of the Imperial Japanese Government, over which the only messages from Tokio to the outside world were transmitted for some time after the recent catastrophe. The tower, built of reinforced concrete, stands 660 ft. above the ground level and 672 ft. above the bottom of the footings.

USEFUL OPERATING IDEAS

Construction of Wooden Mine Doors

The details of the construction of mine doors used underground have received little attention, although many such doors have been constructed and are in use. The important requirements of a mine door are lightness, stiffness, and an economic use of materials. Under most conditions the door cannot be placed within a frame, but must come without the frame due to the fact that the settlement of mine timbers would jam an ordinary door. The door bears against the face or side of the frame which is most conveniently of rectangular shape. It swings in one direction. Where the door is used to cut off an air current it is placed so as to be held shut by the air current, and where necessary to be left partly open for the passage of an air current of given volume it must be provided with a chain or other means of attachment to hold it in a fixed position. The bearing face of the door must be smooth so as to be practically airtight. This requires that the fixed bearing surface be in one plane and smooth also.

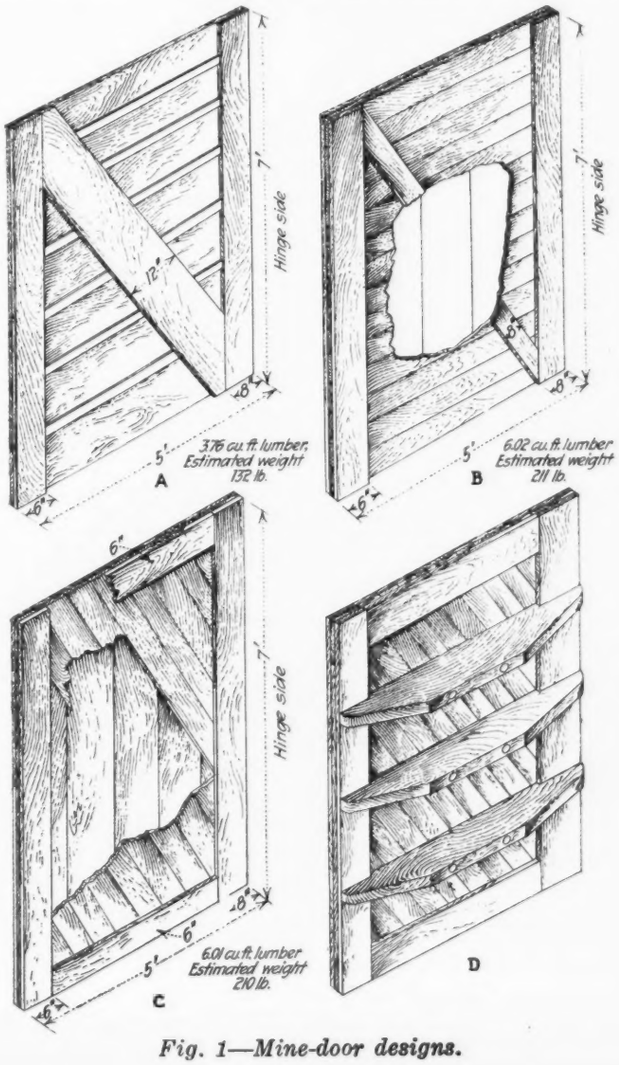


Fig. 1—Mine-door designs.

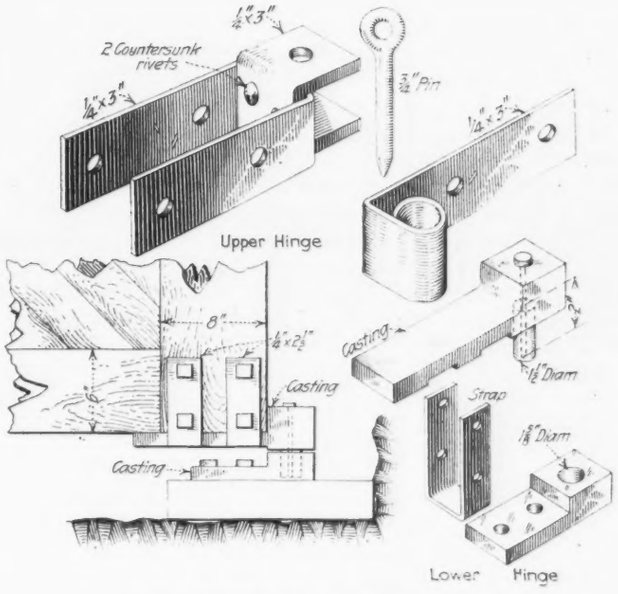


Fig. 2—Details of mine-door hinges.

To secure air-tightness about the mine timbers supporting the door, it is necessary to fill the spaces between timber and walls with concrete. A catch that can be operated from either side is considered in some instances to be necessary. Where the door is to be opened against considerable air pressure a counterweight, pulley, and wire rope are provided. Automatic appliances for opening and closing the door are occasionally used. Air-tightness at the bottom of the door can be secured by a strip of belting or by reducing to a minimum the clearance necessary for swinging.

Four types of wooden doors are shown in Fig. 1. *A* is the simplest and lightest. The estimated weight is 132 lb. The cracks are battened. The side strips, in addition to being nailed, are also bolted to the cross boards at the top and bottom and at two intervening points. The diagonal bracing board is preferably bolted at top, bottom, and middle, and nailed at intervening points.

Lumber one inch in thickness faced on one side is used for the construction. *B* is made of two thicknesses, the face boards being one foot in width and the cross boards one-half foot in width. Tongue-and-grooved boards can be used and will secure greater tightness. The same objective can be secured by a layer of heavy building paper between the two layers. Lumber one inch thick is intended to be used. Side strips and diagonal brace should be both nailed and bolted. The weight of this door is estimated to be 211 lb. In *C* the second thickness of lumber is laid diagonally over the first layer. Side and top strips are used and are bolted as well as nailed. Air-tightness can be

secured by tongue-and-grooved diagonal boards or by the use of building paper. Where a heavy air pressure must be withstood the side of the door toward the pressure can be braced as shown in *D*. This retains the lightness of the construction and secures greater stiffness.

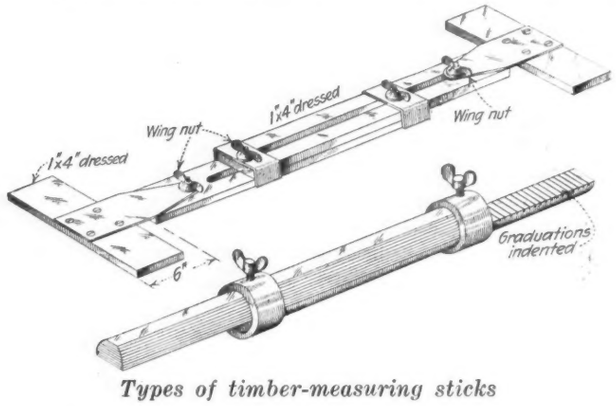
In the sketches, a 5x7-ft. door has been indicated. By using thicker boards a heavier construction can be obtained. The design of larger doors would be similar, but would undoubtedly require heavier lumber.

Designs for upper and lower hinges are suggested in Fig. 2. The upper hinge is made from merchant iron and is provided with a pin for convenient dismantling of the door. The lower hinge is made of two simple castings, one of which is bolted to the door by two straps and the other is attached to a foot block by lag-screws. Undoubtedly, other designs could be developed to meet the peculiar conditions of a given mine.

Fireproofing of doors presents a difficult problem. Gunite could be used and if properly maintained might be satisfactory. A sheet-iron door properly braced by angles could be designed for this objective. Covering the wooden door with light sheet iron would result in a fire stop that would function for a time. In general, the subject of the construction of fireproof doors affords a fruitful and essential topic for discussion.

Measuring Timber Sizes

To measure mine timbers of irregular length, a convenient form of slide staff that admits of various modifications to meet individual conditions is described in Bulletin 215, U. S. Bureau of Mines. The staff is constructed of 1x4 in. dressed pine and consists of two



Types of timber-measuring sticks

symmetrical parts which slide in a pair of metal bands and are held fast by wing bolts attached to the metal slides. Two end pieces are provided and are arranged so as to be angled to fit the slope of the walls and can then be clamped into position. Thus the staff can be used directly to mark the timber to be cut. The accompanying illustration shows two modifications of the slide staff.

Money Saved by Reducing Belt Slip

By W. F. Schaphorst

To show how important it is to reduce belt slip to a minimum, I have prepared the accompanying chart. Much more power can be saved in this way than is generally believed. As an example, let it be assumed that a main driving belt, transmitting 100 hp., slipped 4 per cent. Changing the pulleys to a larger size would reduce the slip to 2 per cent. The saving or difference in slip is therefore 2 per cent. To use the chart connect the horsepower transmitted, Column A, with the difference in slip, Column C, and the intersection with Column B gives the annual saving in dollars. Thus the dotted line drawn across this chart

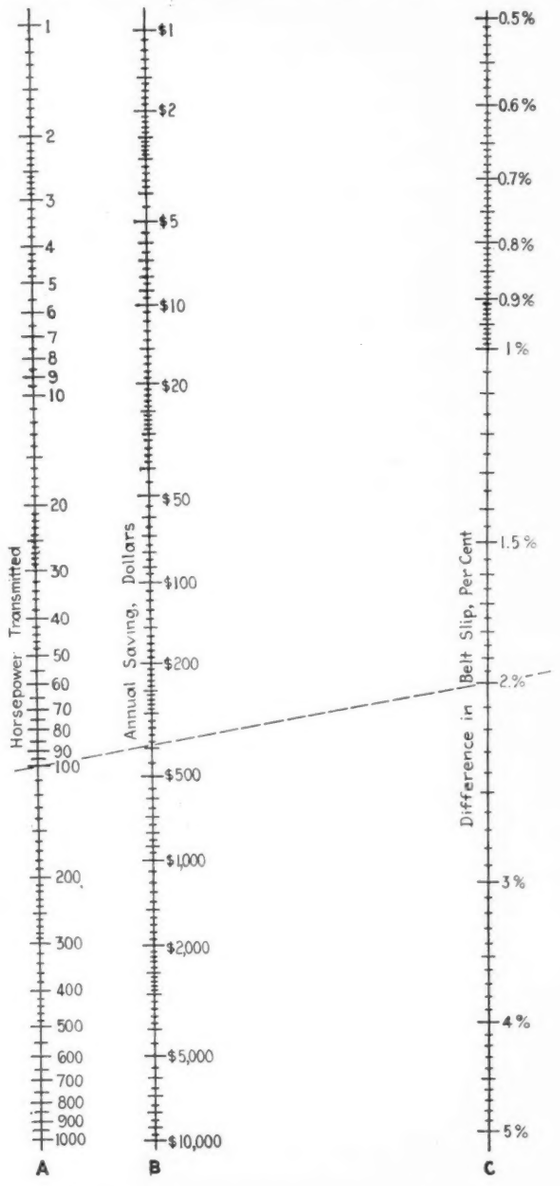


Chart for determining cost of belt slip.

solves the foregoing problem where 100 hp. is transmitted and where the difference in belt slip is 2 per cent. The annual saving is nearly $400, as the intersection of the line with Column B indicates. The chart is based upon continuous operation and upon a power cost of 3c. per kw.-hr., which is a conservative figure.

Where the cost of power is more or less, divide the figure obtained in Column B by 3 and multiply the result by the actual cost in cents. The product will be the annual saving in dollars. Thus, if the cost of power is 5c. per kw.-hr., the cost for 1c. per kw.-hr. would be $133.33 and for 5c. per kw.-hr. $666.67, the annual saving. I have made the range great enough to take care of nearly every case where power is transmitted through belting.

The Mexican Primary

By T. A. Rickard

THE MARCHING and counter-marching of small bodies of armed men across the melodramatic stage of Mexico need cause no acute anxiety even among those who wish well to our southern neighbor; the performance we are witnessing is the normal preliminary—or primary—to a presidential election in that country. The Mexican election is scheduled for July next; our own is set for four months later, and we are preparing for it also, but in a different way, by preliminary attacks on the aspirants for the august job; however, instead of rifles we use newspapers, which are firing hot shot and poison gas at the candidates of the opposing side. We have not as many generals on the stage as the Mexicans, but we have many "colonels" and "favorite sons," besides "our Henry," who one day is a candidate and the next is patting President Coolidge on the back. In short, our election is a civilized affair; the Mexican, according to our standards, is barbarous; but it must be confessed that Macaulay's New Zealander, or any similarly detached observer, would find neither lacking in humor.

Our hearts need not bleed for the people of Mexico, for after a month's attacks and counter-attacks not as many have been killed as in an unrecorded skirmish in the Great War. After a while it will become apparent whether those in power or those in revolt are going to win, whereupon numerous desertions from the losing to the winning side will bring the affair to an end, and at a conference of the successful leaders it will be decided who is to have the nomination. The primary will be over. The game as played in Mexico makes it necessary to find out who is going to win and then run to his side. To ascertain that the active voters, of whom there are not many in proportion to the population, are called upon to seize their guns and mount their horses under the leadership of one or more of the numerous generals, who constitute the effective politicians of the country. The election itself is a formal affair, for, once it is clear who is to be elected, it is not customary to vote against him, because the polling stations are in the hands of his friends and any recalcitrancy is deemed unseemly, if not positively dangerous.

In time the Mexican will learn the folly of allowing himself to play the part of a pawn—it is the part of a pawn to be sacrificed in a gambit; but before he learns that he will have to learn many other things. Formerly when he followed the lead of one of the intriguing generals in an insurrection he had the chance to loot; the commander got the treasure and his followers the pickings, but brigandage is no longer as profitable as it used to be, and with the decrease of profit the *revoltosos* will decline in number. That is the story of the South American states; they went through a similar experience and some of them have not wholly emerged from it. The national choice of a President by means of an election presupposes an intelligent electorate; in the United States the supposition is a dream; in Mexico it is a joke.

Every thoughtful person must hope that the current revolution in Mexico will collapse, for the recurrence of these political disorders will cease only when they fail and in their failure bring their logical punishment —an appointment at dawn in front of a stone wall. As a people we desire to have an orderly neighbor; we desire to see the government of Mexico assert its authority successfully. Only recently our government took steps formally to recognize the administration of President Alvaro Obregon, on the understanding that the claims of Americans in Mexico would receive just treatment. It seems entirely proper therefore that the government at Washington should agree, in response to an anxious request, to sell munitions of war to the Obregon government, because the revolutionary outbreak of De la Huerta and his friends involves no democratic principle; it is merely an attempt to obtain power by force of arms. How the affair started can be stated in a few words:

Obregon's term of office expires in December; by the constitution and his own pledge he can not succeed himself. Among his closest associates were Plutarco Elias Calles, Minister of the Interior, and Adolfo de la Huerta, Minister of Finance. It was decided by these three leaders that Calles should be the presidential candidate, and that the other two should support him. On Sept. 1 Calles resigned from office and announced his candidature, with Obregon's hearty approval. A week later he published his platform, which was so frankly communistic that his own party—which was the party of Obregon and De la Huerta also—disowned him, and by a large majority called upon De la Huerta to run for the presidency, and at the same time asked Calles to release De la Huerta from his promise not to be a candidate. Calles refused; whereupon, on Sept. 24, De la Huerta resigned as Minister of Finance and accepted the nomination of his party, the Cooperatistas—a pretty name. The minority clung to Calles, who continued his political campaign vigorously. Things began to get warm. On Oct. 3 a free fight in the Chamber ended with the killing of a Deputy. Similar affrays ensued in the cafés and on the streets. The bitterness between the two rivals was intensified when Alberto Pani became Minister of Finance and brought forward charges of misdoing against his predecessor, De la Huerta, who had spent $500,000,000 needlessly on government employees, so it was alleged. President Obregon indorsed Pani's report and requested De la Huerta to explain. Whereupon the Minister of Industry resigned; and General Enriquez Estrada, the military Governor of Jalisco, demanded a Congressional inquiry into the charges against his friend, De la Huerta, the former Minister of Finance. On Oct. 30 De la Huerta issued his defence, and attacked both Pani and Obregon. At this juncture Mr. Samuel Gompers, as President of the American Federation of Labor, made a speech in behalf of Calles as the friend of Labor, to which De la Huerta replied by alleging the connivance of Calles in a plot to assassinate Deputies of the opposition. Soon after, on Dec. 5, the friends of De la Huerta assembled at Vera Cruz and revolted against the Obregon government. Since then there have been numerous military clashes of a minor description, and several attempts to bring about a compromise between the factions. In the end, probably, the two extremists, Calles and De la Huerta, will be set aside in favor of a moderate man, not so prominent as to have too many enemies. The primary will, let us hope, prove a successful method of finding a good President for the United States of Mexico.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

An Inexplicable Oversight

THE EDITOR:

Sir—As the years slip by and the area of the bald spot increases, one must, I suppose, be prepared for shocks, but however we may recognize their probability as a philosophical concept, they leave us none the less with a sense of pained surprise. At the moment I am suffering from such feelings induced from reading the announcement at the head of your editorial columns Jan. 5. The list of former editors of the *Mining and Scientific Press* that you print is a list of notable names of men who have deserved honor from their profession. I do not like to claim rank in the latter particular, but I do lay claim to the right of inclusion among those who contributed to the making of the old *Press*.

After a year as Associate Editor, I served, for nearly five years, as Editor of that journal. It is true this was in the days "before the war," and in our quick-moving ages that relegates the matter into ancient history. But I was Editor and proud and happy in the position. Never was editor's responsibility and authority more coterminous or less limited. The one extended to facing a libel suit threatened by a disgruntled promoter and the other to rejecting the manuscript submitted by the chief owner of the paper, himself an able editor and brilliant writer. I may add that on that occasion Mr. Rickard, with his characteristic sportsmanship, wrote that while he regretted my decision he recognized that an editor could not carry responsibility without authority and that it was proper for an editor's decision to be accepted as final.

Those days on the *Press* are days I like to recall. They were days of hard, continuous work, but of work that was inspiring and broadening, and they brought me friendships in the various parts of the world that I treasure highly. I like to think they counted for something and that they contributed toward building up something in our profession that still lives: a certain spirit of fellowship, to the leadership in which the *Journal-Press* succeeds.

Please, Mr. Editor, may I not be restored to good fellowship among the goodlie companie of ex-editors?

Washington, D. C. H. FOSTER BAIN.

Who Knows Robert Rusk?

THE EDITOR:

Sir—I wrote some time ago to Mr. E. J. Scovil, Golden, B. C., asking if he could tell me anything about a Robert Rusk who left there for the Yukon about 1886 or 1888. He went to Golden about 1880, forty-four or forty-five years ago, but I am not sure of the exact date he went to the Yukon. We have lost track of him for some sixteen or eighteen years (perhaps a little more). Mr. Scovil assures me you will publish a query as to an old timer, Robert Rusk, in the Yukon, of whom we have lost track.

He worked in the mines at Golden, then went with a party of twelve or fourteen to Yukon. The last we heard of him he was in Nome.

If you feel like doing this I will be very grateful. Robert Rusk, who is my brother, lived in Paisley, Ont., before going to Golden. MRS. W. S. GIVEN.

Shreveport, La.

What's Wrong With Assaying?

THE EDITOR:

Sir—In your Jan. 5 issue you had an editorial, "What's Wrong With Assaying?" This question, I believe, will be found in the last analysis to be a problem in advancement.

You point out the great importance of assaying about a mine and mill, and that it is work that calls for skill and deftness that practice alone can give. You also point out that it is often so monotonous and tiresome that only a certain type can contentedly put his nose to the grindstone of assay laboratory routine and grind away day in and day out, week after week, without a holiday except perhaps Fourth of July and Christmas and a chance flooding of the mine or the breakdown of the mill. What you say about assaying applies to hundreds of other jobs. It is certainly just as you say, "It all depends on the type of man—there is nothing wrong with the work, any more than there is with a hundred other jobs that require little mental exertion." The question is, how to get that type of man? You pointed out how assaying, because it offers so very little opportunity for advancement, did not draw to it men who might be very well fit for the work. The problem, as will be seen, is in reality a question involving the matter of advancement.

The problem of advancement is, at the bottom, how to abolish what industrial engineers call "blind-alley" jobs—that is, positions into which some member of the organization drifts with no chance whatever for advancement.

Our noticeable failure to find a satisfactory solution of this problem has been due to not giving the proper consideration to the different abilities men have at different periods of their life. Prof. Stanley Hall, I have read, divides a man's life into seven periods. It is reasonable to suppose that in each of these periods a man is better fit or able to do certain things than at any other period, and less fit to do other things. For instance, men are perhaps better fit for active management of affairs between the age of forty and sixty than at any other age; and better fit as councilors between sixty and seventy than any other age.

A great deal has been said about the conservation of our resources and our labor power, but hardly any-

thing about conserving and using the vast store of knowledge and experience in possession of the old and, in fact, in possession of all human beings. There is no well-organized machinery to pass the knowledge that all possess in the various periods of their life back to those that follow. This waste, to my mind, is the greatest of all wastes. The problem of how to avoid this waste is also the problem of advancement. It is the problem of making the best use of a man's abilities as he advances through life. How are we to do this?

Prescott, Ariz. WILLIAM CROCKER.

The Case of the "Fred J. Wood"

THE EDITOR:

Sir—It was with the utmost surprise and disappointment that I read the leading editorial under the head "Vicissitudes of the Gold Seeker" in the issue of Dec. 8, 1923. Having received and read nearly every issue of the *Journal-Press* for the last ten years, I had begun to place absolute confidence in the accuracy of both the editorials and articles contained therein. I have been in full accord with its policies during the ten years of my acquaintance with it, and it was my opinion that all information which it contained was reliable in so far as the editors were able to make it.

I have been with the Eldorado Development Co. for the last year and with the same interests for the last eight years. I have spent fifteen years in Nome, Alaska, and my work is still there. It is needless to say that I resent the above-mentioned editorial very much.

Last season I went to Nome on the company's vessel, the "Fred J. Wood." We arrived late, Aug. 9, and immediately went to work on the company's properties near Nome. I was in charge of the 2¾-cu.yd. gold dredge on Osborne Creek about 9 miles from Nome and spent most of my time there. At this point I will mention that the ground which we are now dredging ran 49.14c. per cubic yard last season (1923) and for the last eight seasons has averaged 51.72c. per cubic yard, which is close to the average value of the yardage handled by all of the dredges in Alaska in 1922. The majority of the men employed by this company, however, were at various ditch camps on construction and repair of one of the largest ditch systems used for hydraulic mining on Seward Peninsula.

As regards the "Fred J. Wood": After she was unloaded at Nome the captain took her to Port Clarence Bay, a safe harbor, very much like San Francisco Bay, about 100 miles northwest of Nome. Through negligence he let her go ashore Sept. 17, in a 34-mile southerly wind (winds from that direction and of that velocity are very common along that coast in the fall) with most of her ground tackle in the chain lockers or lashed on deck. Upon his return to Nome he was given such an unwelcome reception from the city that he left on the first boat. During his stay in Seattle, with revenge toward the company and the people of Nome uppermost in his mind, he wrote a story, the essence of which was inaccuracy, gave it to the *Seattle Post-Intelligencer*, which printed it under photographs of himself and wife. Parts of that story were printed in most Coast cities. Several San Francisco papers "lifted" the entire *"P.-I."* story, and I presume your version was obtained from your San Francisco office without further investigation.

No one "sold his clothes to insure continued association of body and soul until work was secured in some local industry." Every man in the employ of the company at Nome boarded at the company mess houses at the camps or in town, and his transportation was furnished by the company at the end of the season to the city from which he came. All employees were under contract with transportation furnished both ways, board and room. The company broke no contracts.

There was no "distress caused by the last disaster which it would seem that if any funds were available the company might well have taken steps to relieve."

The ship did not "deliver the freight, human or otherwise ashore at Port Clarence," as she had discharged her entire cargo, which contained a large shipment of coal, about six weeks previous at Nome.

As an employee of the Eldorado Development Co. in the engineering department I keenly resent the above-quoted statements along with many other inaccuracies which the editorial contained. I am loth to believe that it was a matter of misplaced confidence on my part as regards the accuracy of the contents of the *Journal-Press* and feel that lack of sufficient investigation on the part of its correspondents has kept the facts of this case from the editorial writer. W. H. MOORE.

Los Angeles, Calif.

When the Doodle Bug Balks

THE EDITOR:

Sir — In looking over some recent issues of the *Engineering and Mining Journal-Press*, I noticed that Mr. William Guest, with his doodle bug, is operating at Goldfield. If he can put over his stunt among a group of level-headed, show-me, sensible business men as one would be led to believe make up the bulk of the Goldfield citizens, I believe he is entitled to a banquet.

I am always looking for information and am a willing listener. About a year and a half ago I was introduced to Mr. Guest and his doodle bug, by a local mining man, who had great faith in the powers of the doodle bug. Knowing this man to be a conservative, sound business man, endowed with more sense than God gives geese, I concluded to investigate the doodle bug.

I began to lose faith in the contrivance as soon as I learned that its motive power was a container filled with radium salt, held together with two corset steels. Among other claims made by Mr. Guest was the absolute assurance he gave me, that without any possibility of doubt, the contrivance could locate oil and tell the exact depth, amount, width of any oil field located any place on the face of this deceptive earth. I talked this over with "Bill," one of the special writers of the *Evening Express*, and we decided that here was a chance to recuperate our fortunes; we would take him to Signal Hill and try the doodle bug. So "Bill," accompanied by Mr. Irving Augur, then with the Bureau of Oils in this city, and Mr. Guest, with his doodle bug, made a trip through the oil fields. On account of other business I was unable to accompany them. "Bill" reported that when they reached Signal Hill the doodle bug refused to play. It absolutely and irrevocably showed by its action that the oil at Signal Hill was so insignificant that it wasn't worth while acting up. And Mr. Guest confirmed the action of his doodle bug. Enough said. IDA I. DAVIS.

Los Angeles, Calif.

Societies, Addresses and Reports

Petroleum Situation Surveyed by M.M.S.A.

Concluded Country Will Soon Be Where Rewards to Promote Discovery of Larger and Richer Fields Will Be Warranted

THE petroleum committee of the Mining and Metallurgical Society of America has presented the second of its reports on the basic facts underlying the petroleum industry, this being a statement concerning the production and consumption of crude and refined petroleum products in the United States from 1910 to date. This is accompanied by various tables and graphic charts, and it states as follows:

A survey of the oil situation as a whole shows certain striking points of interest. The more noteworthy of these are the following:

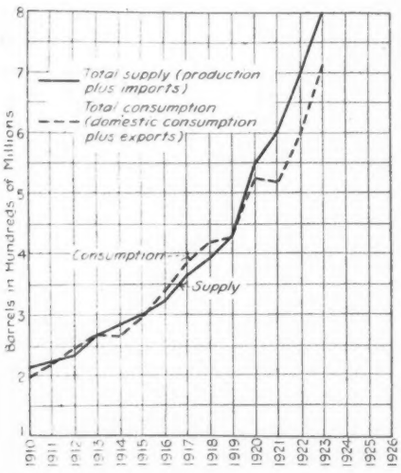


Chart A, showing supply, consumption, stocks, imports and exports of petroleum (crude and refined) in United States by years 1910 to date.

1. The *rate* of petroleum consumption (domestic consumption plus exports) is increasing more rapidly than the *rate* of supply (domestic supply plus imports). (Chart B.)

2. Chart A, which is based on annual *rates* of supply and consumption, plotted on a yearly basis, shows that from 1910 until the beginning of 1920 the *rates* of consumption and supply both increased steadily and rapidly, but because of post-war depression felt by all industries, the increase in the *rate* of consumption was halted for about one year while the increase in the *rate* of supply continued unchecked.

3. Beginning with 1921, the *rate* of consumption resumed its rapid advance and until the present time has been running parallel with the *rate* of supply; nevertheless, *actual* consumption has not yet overtaken the *actual* current supply.

4. Present indications are that within the next year the current supply will fall below consumption.

5. During 1920, 1921, and part of 1922, supply has been greater than consumption for two reasons: first, the reduced consumption in 1920 just mentioned, and second the heavy imports principally from Mexico. The ratio of imports to domestic production during recent years is illuminating, and is as follows:

Year	Domestic Rate of Production, Barrels	Rate of Importation, Barrels	Ratio of Imports to Domestic Production, Per Cent
1910	209,557,000	571,354	0.25
1919	378,367,000	54,161,216	16.00
1920	442,929,000	108,793,838	25.00
1921	472,183,000	128,775,982	27.00
1922	557,531,000	135,947,300	24.00
1923	702,841,000	100,185,768	14.00

6. During the latter part of 1922 and 1923, the domestic supply itself has been largely increased by the production of seven or eight new fields in the United States, the most phenomenal of which have been Long Beach, Huntington Beach, and Santa Fe Springs, in California, and the Powell field, in Texas.

7. This increase in domestic production, together with imports, has brought the annual *rate* of supply up to the tremendous figure of 809 millions of barrels for 1923, as compared to the figure of 210 millions for 1910, or as compared to 395 millions for the year 1918, when the United States was making a maximum effort to produce oil for war purposes.

8. As a natural result of the increase in supply, stocks of petroleum in storage have accumulated. The actual figure for the end of September of this year (442 million barrels) is startling, unless looked at in the proper perspective, that is, its ratio to consumption, which is expressed in the number of "days' supply." The number of "days' supply" has actually been decreasing since June of this year and the September figure of 199 days' supply, at the then *rate* of consumption, has been reached or exceeded in 1917, 1919, 1921 and 1922.

Chart B shows in more detail the movements of supply and consumption of oil from 1917 to date, plotted by months but on an annual *rate* basis, in order to indicate the current relative position of these two factors such as is not indicated on Chart A, which is plotted annually on an annual *rate* basis, and only shows 1923 *rates* calculated on the basis of the returns for the first eight months of the year.

9. Production of petroleum from every field in the United States is either stationary or decreasing, with the sole exception of the Powell field in Texas, which has recently reached a daily production of over 325,000 bbl.

10. Imports also are on the decline, the *rate* for 1923 being estimated at 100 million, as against 136 for 1922.

11. As soon as production in the Powell field starts to decline, the relative positions of supply and consumption will quickly be reversed, and it will be necessary to draw upon stocks of petroleum in storage.

12. Reference to various authoritative published estimates of the oil possibilities of the United States and the rest of the world will show that there is every reason to believe there exist adequate resources of oil in the world to meet all present and future demands for many years to come.

13. Study of the causes and methods of increase of production indicate that rising prices are the main factor. The remedy then to obtain a supply to keep pace with future consumption is to increase prices. This fundamental economic method of control of supply and demand, however, rarely goes into effect except when the commodity actually becomes scarce.

14. Under the incentive of rising prices various new fields have been discovered in the past and others undoubtedly will be found in the future. From the time of discovery of an oil field until near exhaustion sets in, there is no known method of adequate control of production in new fields. During such a period (like the one we are just emerging from) the oil industry as a whole suffers from economic conditions beyond human control.

15. The relief factor that appears under such circumstances is the rapid expansion of consumption under the stimulus of an abundance of low priced oil.

The conclusion drawn by the committee charts is that before long the United States will again enter the phase of this cycle which calls for the offering of rewards for the discovery of larger and more prolific fields than have been found to date, in order to keep pace with the ever growing consumption.

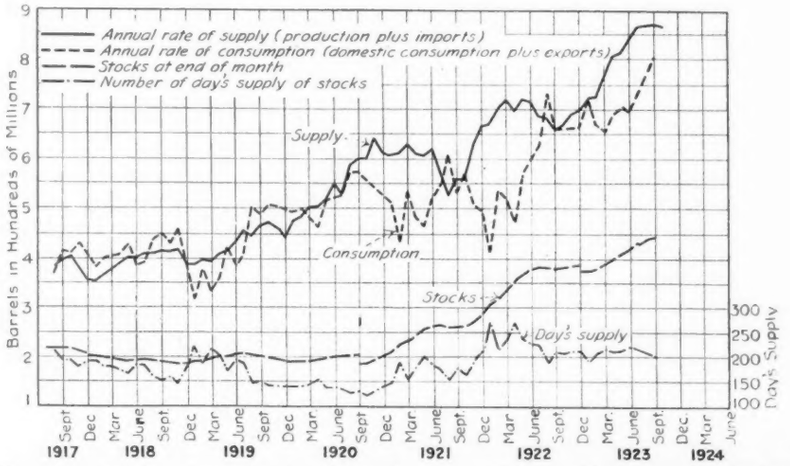


Chart B, showing annual rate of supply, consumption and stocks of petroleum (crude and refined) in United States by months from August, 1917, to date.

MEN YOU SHOULD KNOW ABOUT

H. C. Bellinger, vice-president of the Chile Copper Co., sailed from New York

H. C. Bellinger

on Jan. 10 to inspect the Chile Copper Co.'s properties at Chuquicamata.

Mr. and Mrs. Daniel C. Jackling and Mrs. Emery Sands
On the deck of the "Santa Elisa," which sailed for South America on Jan. 10

Daniel C. Jackling, and Mrs. Jackling, left New York on Jan. 10 on the Grace liner "Santa Elisa," for Chile and Bolivia, to visit the Guggenheim properties in South America, in many of which Mr. Jackling is a director.

W. G. Swart, general manager of the Mesabi Iron Co., is in St. Louis.

Frederick Bradshaw has resigned as general manager of the Tonopah Belmont Development Co.

J. S. Negru has been appointed editor-in-chief of the *Revue Universelle des Mines,* Liége, Belgium.

H. Foster Bain, director of the Bureau of Mines, is spending a week at the Pittsburgh station inspecting experimental work in progress there.

C. M. Weld, of Weld & Liddell, consulting engineers, has returned to New York after a two weeks' absence in West Virginia and Michigan.

Joseph Clendenin recently sailed for Europe to make arrangements on the Continent for marketing the copper production of Kennecott, Braden, Mother Lode Coalition, Nevada Consolidated, and Utah.

A. W. Allen, who has been in New York since Nov. 15, directing the compilation and publication of the *Journal-Press* Review Number and Year Book, has returned to San Francisco.

Tom Aitken, one of the most successful dredge operators in Alaska, recently completed the long trail trip from McGrath to the Government Railway at Nenana. He will continue to California for a well-earned vacation until the opening of the spring season.

L. F. Bullard, superintendent of the Nixon Fork mine, in the Kuskokwim District, Alaska, and owned by the Alaska Treadwell Gold Mining Co., recently reached Nenana, Alaska, after completing a 350-mile dog-team trip from the mine. The company's records and certain equipment were brought out over the trail, for the Treadwell company has suspended operations indefinitely.

Justice F. Grugan, of New York City, has been appointed district manager for the Worrell Engineering Co., constructing engineers. He will combine the duties of that post with his professional activities as a consulting min-

Justice F. Grugan

ing engineer, with offices at 135 Broadway, New York.

OBITUARY

William Hoopes, recognized throughout the world as an authority in aluminum metallurgy, died recently in Pittsburgh. He was chief engineer of the Aluminum Company of America.

Senator Michael Moriarity ("Merciful Mike") is dead. He held a one-third interest in the fee of the Sherwood iron mine, at Iron River, Mich., which property is one of the iron-ore reserves controlled by the Republic Iron & Steel Co.

Otto J. Laist died recently in Oakland, Calif. Laist was a graduate of Leipsic University, and a well-known chemist. Frederick L. Laist, general manager of the Anaconda Copper Mining Co., is one of the five surviving sons of Otto J. Laist.

Prof. F. Clowes, who occupied the chair of chemistry at University College, Nottingham, England, from 1881 to 1897, when he became chemical adviser to the London County Council, died on Dec. 18. Prof. Clowes was eighty-five years old.

Dr. Philip Edward Chazel died in Charleston, S. C., on Jan. 13. He was the son of the late Dr. J. P. Chazel. Dr. Philip Chazel was born on June 25, 1857. He was graduated in 1876 at the College of Charleston as the first honor man of his class. After a short time in the Shepard Laboratory under the late Dr. C. U. Shepard he entered the School of Mines at Columbia University, New York, from which he graduated at the head of his class in mining engineering. He is survived by his widow, two sons and a daughter.

Samuel Austin Worcester died on Jan. 10 in Butte, Mont. Mr. Worcester was a native of Cincinnati, Ohio, and came to Butte four years ago. He was chief mechanical engineer of the Davis-Daly Copper Co. and was affiliated with the Montana Society of Engineers and the Mount Moriah Lodge of the A. F. & A. M. of Butte. Besides his wife he is survived by three sons, Harold S. in Telluride, Colo.; Samuel Austin, Jr., and Leonard; a daughter, Miss Carrie, of Butte; three grandchildren in Colorado and a brother in El Paso, Tex.

Williard A. Deane died at Nichols, Fla., on Dec. 26, at the age of forty-four. Mr. Deane took a special course in metallurgy at Lehigh under Dr. Richards, and was graduated from the Michigan College of Mines. From 1905 to 1916 he held positions of responsibility at different operations in Mexico, the United States, and Canada. He was a member of the American Institute of Mining and Metallurgical Engineers and the Chemical Society, and was the author of several articles on chemical research. He leaves a wife and two children.

THE MINING NEWS

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Summary of the Week

TERMS for the merger of the Ray Consolidated Copper Co. and the Chino Copper Co. have been agreed upon by the directors. If the shareholders approve the plan an exchange will be made on the basis of 1⅛ shares of Ray for 1 share of Chino.

Bonanza ore has been discovered in a wide shoot in the Kirkland Lake Gold mine just in time to prevent or delay purchase by the Teck-Hughes company.

New Cornelia's new 5,000-ton flotation concentrator at Ajo is in operation.

Financial arrangements have been completed for the exploitation of a second iron-ore property in southern Utah.

Development operations have been resumed by the Trojan Mining Co. in its gold mine in the Black Hills in South Dakota.

A million-dollar fire destroyed one of three iron-ore docks at Ashland, Wis.

Vacating actions between the Anaconda Copper and Davis-Daly companies indicates a compromise of apex litigation. The absorption of Davis-Daly by its powerful neighbor is suggested.

The Royal Tiger Mines Co. has started its new concentrator at Breckenridge, Colo.

In Michigan thirty-two copper mine shafts are idle, pending improvement in the copper situation. Rich areas only are being mined.

Mill construction is being considered by the Indian Mines Co. of British Columbia.

Shutting down of the Humboldt smelter in Arizona by the Southwest Metals Corporation is the result of the poor copper market.

Already on Bargain Counter, Kirkland Lake Finds Bonanza Ore

Absorption by Teck-Hughes Off for Present—Mill Heads Jump from $5 to $35

A recent discovery of high-grade ore on the 1,100 level of the Kirkland Lake Gold has entirely altered the status of this northern Ontario mine and has, for the time being at least, destroyed the possibility of its being taken over by the Teck-Hughes, which adjoins it. The discovery was made in a short crosscut from what was believed to be the main vein, and shows an average of over $100 a ton across a width of 5 to 6 ft. It is now thought possible that this is the real vein which branched off at the 700 level, and that there are possibilities of similar shoots between the 1,100 and 700 levels.

The discovery was of the story-book variety, and was made at a dramatic moment. The property had been operated for several years, with an average recovery of about $5 a ton, which was hardly enough to pay operating expenses, much less make any provision for the heavy interest charges on the company's debt. In addition to its other troubles, it was from this poor Cinderella among Kirkland mines that high-graders, a couple of years ago, stole cyanide precipitates to the amount of about $20,000. The directors, discouraged by these conditions, were faced with the closing down of the property, when they were approached by the Teck-Hughes, which was in need of another shaft and increased milling facilities, with an offer to purchase. Though this purchase would have provided for the liquidation of the company's indebtedness, it is doubtful if there would have been anything left for Kirkland Lake shareholders. The directors had already met to consider the Teck-Hughes proposal, when the news of the discovery came. Mill heads, with a small addition of this rich ore, jumped from $5 to over $20 and were one day up to $35. It is, of course, too early yet to say what the discovery really amounts to, but it shows ore of a higher grade than the company has ever had before, and may be the means of re-establishing its affairs. The Kirkland Lake Gold is controlled by the Beaver company of Cobalt. Teck-Hughes shareholders feel that the discovery was made just a little too soon.

Kolar Gold Production Declines

The gold production from the Kolar area of Mysore State, India, has gradually declined from 520,000 oz. in 1917 to 391,000 in 1921. This represents a net falling off of about 129,000 oz., with an approximate value of £500,000 since 1917. It is the opinion of the company geologists that there is enough ore to warrant operations for ten years.

Michigan Copper Country Has Thirty-two Idle Mine Shafts

Improved Metal Market Would Reopen Many of These—Close Selection Necessary

There are thirty-two idle shafts in the Michigan copper district, either capable of production or having good prospects, awaiting a higher metal market. With a reasonable advance in the price of copper, many of these shafts could be made to pay by resorting to keener copper-rock selection than previously employed. Until metal does advance, however, there is little prospect of resumption in the majority of them.

Calumet & Hecla Consolidated has six idle shafts on the Osceola amygdaloid lode. The yield from these was 14 to 15 lb. of refined copper per ton of rock treated, which could be increased perhaps 2 or 3 lb. by mining only the richer areas. In these shafts, the company has resources good for many years of operation. It is estimated the vein carries values for a distance of 10,000 ft. along the dip, or 5,000 ft. vertically below surface, and copper in commercial quantity may extend even deeper.

The Osceola mine of Calumet & Hecla Consolidated has two idle shafts which eventually will be reopened. Through No. 6 the most encouraging section of La Salle ground also can be worked, a considerable tonnage having been taken out prior to the shutdown in 1920.

The North Kearsarge branch of the Osceola mine has three shafts which command rock of good grade in the Kearsarge lode. An improvement in the labor situation recently permitted the reopening of one of these shafts, No. 1. Development work, sinking, and drifting are under way. The South Kearsarge branch is practically mined out, although a considerable tonnage remains in the pillars and arches of the two shafts, removal of which would entail high costs.

Ahmeek, also part of Calumet & Hecla Consolidated, has two idle shafts which no doubt will be reopened when there is greater need than now for larger production; Centennial has two idle shafts and Allouez two.

Isle Royale has four idle shafts, probably all of which will be reopened when labor and market conditions permit; Copper Range has three idle shafts at Trimountain, although development and opening work is in progress in No. 2, in which a notable improvement in the copper tenor of the rock has taken place; Mohawk has two idle shafts, although in No. 5 operations were confined at the time of the shutdown of the shaft to removal of shaft pillars from the 14th to the bottom or 21st level. No. 1 shaft, Mohawk, was in fairly good ground when operations ceased there on account of shortage of labor.

Michigan has three idle shafts; Mass, three; Victoria, one; and White Pine, two. The best ground in Michigan was opened in "E" shaft on the Evergreen, Butler, and Ogima veins, and eventually a new shaft may be sunk to the east of "E" shaft to develop the most favorable ground in the property. At Mass, the best shaft was "C," in which good ground was opened on the Evergreen and Butler beds. A new shaft west of "C" may be sunk when conditions seem to warrant this development. Victoria's best showing is in No. 2 shaft, in which good but bunchy ground has been exposed. Victoria, which is equipped with a hydraulic air-compressor plant, has available the cheapest power of any mine in the Michigan copper district. White Pine has a commercial copper showing in both Nos. 3 and 4 shafts. The copper is light and flaky, but the mine is equipped with a flotation plant, which makes a good recovery possible.

Three Gold Properties in California Are Bonded

The old Rawhide mine, near Jamestown, Calif., has been acquired on a working bond by G. F. Snyder. The purchasers have agreed to begin work within four months. An option has been taken upon the Champion mine at Nevada City, in the name of C. P. Jones of Grass Valley. Other properties in the Gold Flat section are included. The Dart ranch in the Rough and Ready section near Grass Valley has been sold under bond to E. W. Griffith and R. E. Smith.

Merger of Ray Consolidated and Chino Copper Companies Awaits Approval of Stockholders

Directors Agree on Terms for Consolidation—Question of Merger With Inspiration Still Discussed—Non-Withdrawal of Ray and Chino From Export Association May Be Significant

THE EXCHANGE of 1,500,000 shares of stock in the Ray Consolidated Copper Co. for the property of the Chino Copper Co. is the basis on which directors of the two companies have agreed on a merger. Approval of this plan is anticipated at the special meeting of stockholders of each company called for Feb. 15. For several months this action has been discussed, frequently with the inclusion of the Inspiration Consolidated Copper Co. in the group. The action of the Ray and Chino companies in remaining in the Copper Export Association, from which all of the Guggenheim interests recently withdrew, is pointed to as lending color to the possibility that a further consolidation may be planned whereby the Anaconda company, through Inspiration, will obtain control of the entire group. Anaconda is the dominating interest in the Export Association today.

Change in Sales Arrangement

After Feb. 1, 1924, the domestic copper sales of Ray and Chino will be handled through the Metal Sales Corporation, which is also the selling agency of Inspiration and Greene-Cananea. The Metal Sales Corporation is looked upon as an Anaconda organization. Heretofore the production of the Ray and Chino mines was handled by Guggenheim Brothers.

In a letter to the shareholders of the Chino company, D. C. Jackling, president, explains that for many years the directors have believed that the ultimate interests of the company and of its stockholders would be best served, from both corporate and operating standpoints, by a closer association with Ray and that the late trend of affairs affecting the copper industry has rendered more pronounced the benefits and economies to be obtained. He says further:

"The immediate benefits to be gained, from the corporate standpoint, lie in a consolidation of business and production that will make for economy and advantage in overhead and organizational expenditures, in the disposition of product, and otherwise. From a strictly operating standpoint, many advantages can be gained through a closer working relationship between productive organizations, both executive and technical, thus making available to either property at all times—and where most needed—the best specialized skill and talent of both. From the standpoint of stockholders, these factors will be augmented by a beneficial diversity of interests wherein best advantage can be taken always of the situation surrounding both properties as a whole, in times of stress, such as have prevailed in the recent past—as, for example, by continuing major scale operations at the most economical producing point and decreasing output at the other, when the metal market would not absorb production from both, or by balancing output when, due to seasonal conditions, accident, labor situation, fuel supply, transportation or any other of numerous causes that may affect output, it is impossible to maintain full production at one property, while at the same time it is quite practicable to do so, or even to increase production, at the other.

"Your company has received an offer from the Ray Consolidated Copper Co. to purchase all of the property and assets of your company as an entirety, for $15,000,000 par value of the capital stock of Ray Consolidated Copper Co. and the assumption by it of all of your company's liabilities and obligations, subject to the approval of both companies' stockholders.

"This proposed purchase price is based upon an exhaustive analysis and comparison of all elements entering into a present worth valuation of the respective properties and their assets following a co-operative survey and investigation extending over several months by the engineers, accountants and operating officials of the two companies. This price will give the stockholders of Chino Copper Co. one and two-third shares of stock of Ray Consolidated Copper Co. for each share of stock of Chino Copper Co. held by them.

Operating Economies Promised

"Your board of directors believes this ratio to be as nearly representative of the relative values of the securities of the two companies as it is possible for the best talent available to determine. They are confident that the proposed purchase and resulting exchange of securities on this basis will make it possible to bring about immediate economies in producing and other costs and benefits in many other directions, including disposition of product, which will at once and for all time in the future insure greater return to the stockholders of both companies.

"Substantially all of the larger stockholders of your company with whom your officers have had an opportunity of discussing this matter have expressed their intention of voting in favor of the proposed purchase, and your directors urge the approval of such purchase by all the stockholders."

The present authorized capital stock of Ray Consolidated is 1,600,000 shares of the par value of $10 each, of which 1,577,179 shares are now outstanding. Chino has outstanding 900,000 shares of the par value of $5 each out of a total authorized issue of 1,000,000 shares.

New Cornelia's 500-ton concentrator at Ajo, Ariz. One unit of the plant was started on Jan. 8

Old Dominion Will Help Employees to Purchase Shares

The Old Dominion Mining Co. has posted notices at its mine at Globe, Ariz., inviting employees to become stockholders in the company and outlining the scheme which has been arranged for financing the purchases made by the men. It is stated that this offer has been made at the request of the employees' committee. The company agrees to purchase its stock at market price on order of the workmen provided they make a cash payment of $5 per share and agree to pay not less than $1 per share per month until the purchase price is paid. Interest on unpaid balance will be charged for at the rate of 6 per cent. If the employee leaves the company he can either complete the unpaid balance or he may ask for a refund of that which he has paid and allow the company to retain the stock.

"Company" Stores Please Customers with Big "Dividends"

The Miami Commercial Co. has announced that over $65,000 will be distributed among the employees of the Miami Copper Co. in Arizona as "dividends" from the earnings of the store during the last half of the year 1923. The store is operated for the benefit of the mining company's employees and the amount to be distributed, representing 19.53 per cent of total sales during the period, is proportioned to each employee according to the purchases made. This is the largest refund to have been made by the store since its beginning, the one that was paid for the first half of the year being 17.114 per cent. The store operated for the employees of the New Cornelia Copper Co., at Ajo, Ariz., likewise recently distributed a refund to its patrons that was almost as large as the one paid by the Miami store. These stores are popular with the employees —especially so at the time of the extra pay-days." Proposed legislation to prohibit them has met little support at the mines, although politicians have agitated the question frequently.

Start First Unit of New Cornelia Concentrator

Second 5,000-Ton Flotation Plant to Be Put in Operation in Arizona Within Year — Expect to Make 8c. Copper

The first unit of the new concentrator of the New Cornelia Copper Co. at Ajo, Ariz., was put into operation on Jan. 8. The first run is proving satisfactory, and it is planned to use two additional units within a month. The remaining two units will then be started one month later, at which time the entire plant will be treating 5,000 tons. It is estimated that the production capacity of the present leaching plant and the new concentrator will be about 8,000,000 lb. of copper per month. An average direct cost of about 8c. per pound of copper is the objective.

The concentrator was built to treat the sulphide ores that are rapidly being reached as the oxide ores are exhausted. Construction was begun in October, 1922. This is the second large concentrator completed in Arizona within a year, the new mill of the Phelps Dodge Corporation having been given its initial tryout last April.

Mendha Mine, Near Pioche, Will Have Mill

The Mendha mine, in the Highland district near Pioche, Nev., is being operated by the Union Mines Co., a new company that has been financed in Los Angeles. The Minerva tungsten mill, on the slope of Mount Wheeler, has been purchased by the new company, and most of the machinery has already been hauled to the Mendha mine, where it will be erected.

White Caps Ships Regularly

The White Caps Mining Co., operating at Manhattan, Nev., shipped gold bullion valued at $28,000 from December operations. In addition, the regular shipments of arsenical ore, amounting to about 150 tons for the month, were made to the Martinez smelter, in California.

Propose Construction of Arsenic Smelting Plant in Colorado

The Colorado Insecticide Incorporated is the name of a new corporation headed by F. C. Gilbert, formerly with the American Smelting & Refining Co. The company has acquired 200 acres of land in the Goose Creek mining district in Gunnison County, Colo. where rich arsenic ores containing scorodite and arsenopyrite have been developed The company plans the intensive development of the field and the construction of an arsenic plant in the Arkansas Valley. The gold- and silver-bearing residues will be shipped to the A. V. plant of the American Smelting & Refining Co. at Leadville, and the white arsenic to Middle Eastern and Southern chemical manufacturers.

Another Utah Iron-ore Deposit Will Be Opened

The Milner interests, of Salt Lake City, are arranging to exploit their Deseret Mound iron deposits in Iron County, Utah. It is said that contracts have been made to deliver a fixed tonnage yearly to smelting companies operating in Salt Lake valley, the material to be used for fluxing purposes. The sale of $250,000 in bonds has been announced, and with a part of the money thus obtained it is planned to build a 3½-mile railroad to connect the deposits with the present branch of the Union Pacific running between Lund and Cedar City. It is expected that construction will start immediately, and shipment is to begin as soon as the road has been completed. It is proposed to mine and load the ore on the cars by steam shovel. In a letter by the president of the company announcing the bond issue, the holdings of the Milner corporation are placed at 527 acres of patented iron lands in the Iron Springs district, with known ore reserves estimated at 15,000,000 tons within a depth of 100 ft. Tests show ore to extend to a depth greater than 340 ft. The property is near that being exploited by the recently reorganized Columbia Steel Co.

Indian Mines Co. Plans Concentrator in British Columbia

Premier's Neighbor Has Seven Ore-Shoots and $300,000 to Spend—Semi-Diesel Plant

G. D. B. Turner, consulting engineer for Indian Mines Corporation, which is operating one mile northwest of the rich Premier mine, in the Portland Canal district of British Columbia, has returned from eastern Canada and United States, where he has been in consultation with the directors of the mine. Mr. Turner has announced that the company has spent $200,000 in development work and he has been authorized to spend another $300,000 in development and equipment. At present forty men are employed, and this number will be increased to 150 by the early spring. The Consolidated Mining & Smelting Co. now is conducting a series of experiments on the ore from the Indian mine, with a view to advising the Indian company as to the best class of machinery to erect to treat the ore. When these tests have been completed a mill of a capacity of between 200 and 300 tons will be erected provided mine development is not disappointing. The mill and all machinery at the mine will be electrically driven, the electricity being generated at tidewater by a semi-Diesel engine plant. The mill will be situated near the main road and about 3½ miles from the mine, and will be connected with the mining operations by an aerial tramway.

Altogether, seven oreshoots have been opened in the mine. The shoot in the No. 1 level has been drifted on for 250 ft., and the face of the drift is still in ore. A crosscut about 50 ft. from the face of the drift gives the vein a thickness of 21 ft., and careful sampling along the crosscut shows a gross value of $25 per ton in all metals, according to the report. There are bands in the vein where the value runs up to $150 per ton, and some of the high-grade will be shipped this winter. The enlarging of the Premier mill and other construction work is planned and a busy year is forcase in the district.

Round Mountain Prepares for Spring Hydraulicking

The Round Mountain Mining Co. is preparing for a busy season at its hydraulic mines at Round Mountain, Nev. A new tail race is being dug to facilitate the working of a proved gravel body north of the Wilson shaft, which is said to run at least $1 per yard. So far the Round Mountain has made no attempt to develop the new channel recently found on adjoining ground by Thomas Wilson, although there is every indication that it will enter and be in company ground for a long distance. The Wilson shaft is about 260 ft. deep and has been in pay gravel for the last 40 ft. Pipe lines and sluice boxes are being laid preparatory to actual gold recovery as soon as water is available in the early spring.

Emma Bee, Old Montana Gold Mine, Ships Again

The old Emma Bee gold mine near Sheridan, Mont., is reported once more to be producing rich ore from a shoot opened up by the lower crosscut.

Shipments will start about Feb. 1. While rich ore carrying $50 or better will go to the smelter, ore of lower grade is being accumulated on the dump for mill feed.

The Emma Bee mine is one of the oldest quartz mines in Madison County, and thirty years ago it was equipped with a stamp mill, run by water power, and the mine is credited with having been a good producer.

The property had been idle until about three years ago, when it was brought by the Smuggler Mining Co., of Butte, which has been opening it up for production ever since. Occasional cars of high-grade ore brought returns of about $50 a ton.

The company expects to have a 50-ton mill in operation during the coming summer.

A winze sunk from the main tunnel level opened up gold ore assaying $32 a ton in a 4-ft. vein. The plan is to sink a working shaft to develop this orebody at depth.

Kansas Exploration Co. Starts New Mill at Baxter

The Kansas Exploration Co. has started its new mill on the Jarret land, north of the Webber mine, west of Baxter, Kan. Three shafts will soon be in operation at this new property, and it is believed sufficient ore to keep the concentrator at capacity will be available. In the new mill the sand jig has been eliminated, a development suggested by experiments of U. S. Bureau of Mines men in this field. Foster S. Naething, of Joplin, is local manager of the company, which is expected to erect other mills in the district during the year. Ross Blake is superintendent at the Jarret mine.

Anaconda and Davis-Daly Halt Litigation Involving Millions

Apparent Settlement May Mean Absorption of Davis-Daly—Ends Suit Pending for Many Months

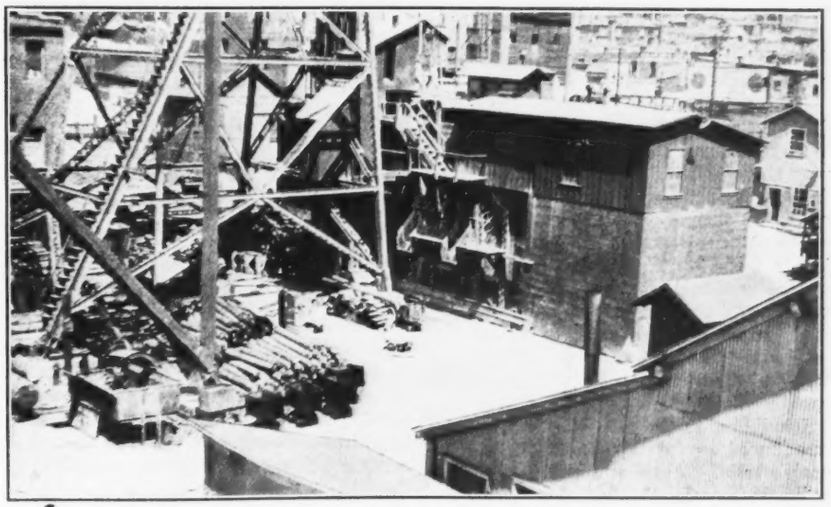
An order vacating the suit of the Anaconda Copper Mining Co. against its neighbor, the Davis-Daly Copper Mining Co., for alleged wrongful extraction of ore from Anaconda property at Butte, Mont., was entered at Helena, on Jan. 9. A countersuit instituted by the Davis-Daly company has also been dropped. The terms of the settlement have not been announced, but reports in Butte indicate that the absorption of Davis-Daly by Anaconda will be the outcome.

Final dismissal of the litigation is contingent on the result of conferences being held in New York by officials of the two companies. In the meantime exploration and development work in the disputed area has been dropped by both sides, and a number of geologists and other experts engaged on litigation work have changed their plans.

The rumblings of this suit were first audible more than a year ago, when Anaconda notified the Davis-Daly company of its contention that the latter had been mining rich copper ore from veins that apexed in claims belonging to Anaconda. Sundry efforts at compromise failed and each company engaged experts to perfect a case based on its interpretation of the geological conditions in the two properties. The case, after several delays, was set for hearing in the Federal Court on Feb. 1 of this year.

Tonopah Bullion Shipments "Normal"

Bullion shipments from the Tonopah district, in Nevada, for December totaled 375,000 oz., containing gold and silver in the ratio of 1 to 100 by weight, with a value of approximately $317,000, Tonopah Extension shipped bullion with a value of $155,000, West End $73,000, and Tonopah Mining Co. $89,000.



Ore picking bins at the Davis-Daly mine at Butte. The property may be absorbed by Anaconda

News from Washington

By PAUL WOOTON
Special Correspondent

Purchase Price of Property Allowable "Loss" Under W. M. R. Act

Court of Appeals Sustains Lower Court—May Reopen Many Cases—Findings of Commissioner Announced —Many Disallowances

PURCHASE OF PROPERTY is an allowable loss under the War Minerals Relief Act an opinion handed down last week by the Court of Appeals of the District of Columbia declares. This upholds a decision handed down nearly a year ago by the Supreme Court of the District of Columbia in the claim of Logan Rives, who carried to the court the refusal of the Secretary of the Interior to allow the loss of $9,600 in connection with a purchase of two tracts of land near Batesville, Ark. The case was appealed by the Secretary of the Interior. It is probable that a further appeal will be taken to the Supreme Court of the United States.

Should the Supreme Court affirm the opinion in which the lower two courts concur, its decision would have a far-reaching effect among War Minerals Relief claimants. Many claims have been made for losses resulting from purchases of property. All of those who have had a part in deciding War Minerals Relief cases have been unanimous in the belief that losses resulting from property purchases did not come within the act. Before the case can be decided by the Supreme Court, it is practically certain that all of the appropriation will have been expended, so that no awards covering purchase of property losses could be made unless Congress should vote additional money. It is regarded as probable that an appropriation would be forthcoming, at least for the continuation of the War Minerals Relief organization. This would be the ready way to examine purchase of property items which heretofore have been passed over without particular scrutiny.

The opinion was written by Chief Justice Smyth. He states that the court is satisfied that, under the statute, it was the intention of Congress to allow for losses incurred by reason of money paid for property, which in this case contained a manganese-bearing deposit. While he holds that all this is provided in the original act, the Chief Justice points out that in the amendatory act it is made even clearer that all net losses are to be paid and rulings contrary to the provision of the amendment are to be reopened.

Findings as to net loss have been announced as follows by the War Minerals Relief Commissioner:

W. H. Kemler, Unicoi County, Tenn., $401; Creath & Jarvis, San Luis Obispo County, Calif., $318; J. L. Hougland, Deming, N. M., $891; Bernard Lemohn, Siskiyou County, Calif., $107; A. W. Sullivan and D. Conser, Siskiyou County, Calif., $661; Henry V. Maxwell, Carter County, Tenn., $1,459; Thomas E. Bourbonia and George W. Saunders, Dona Ana County, N. M., $992; William Blackburn, Cochise County, Ariz., $1,184; Delbert Williams, Yreka, Calif. $551; Manganese Associates, August County, Va., $5,347; W. N. McInnis, Leadville, Colo., $6,134.14; Neal Washburn & Fritz, Mill City, Nev., $996.90; Isaac N. Gaillac, Esmeraldo County, Calif., $190; Western Utah Copper Co., Tooele County, Utah, $5,229.69; Manganese Products Co., Smith County, Va., $15,442.51.

Disallowances were found as follows: Floyd Brown, River County, Calif., stimulation not established; Beaver Creek Mining Co., Philipsburg, Mont., net loss not established; Guy Castiglioni, Nye County, Nev., net loss not established; L. W. Jones and A. G. Jones, Amador County, Calif., not within the act; McGirr & Wood, Fresno County, Calif., net loss not shown; Albert Fredericks, Calaveras County, Calif., prospect; Louis Mankins, San Luis Obispo County, Calif., commercial importance not established; E. G. Harding, Jackson County, Ore., commercial importance not established; J. A. Parker, Siskiyou County, Calif., commercial importance not established; John Cape and Thomas Coulter, Granite County, Mont., net loss not established; William Miller, Imlay, Nev., commercial importance not established; Frank H. Summeril, Maricopa County, Ariz., not within the act; B. F. Sutherland and Sam Tuck, Jamestown, Calif., commercial importance not established; T. E. Bourbonia, Rincon, N. M., withdrawn.

Iron Mining Companies Pay Two-thirds of Taxes

Iron-mining companies in St. Louis County, Minn., which includes the Vermilion and a very large portion of the Mesabi iron ranges, pay more than two-thirds of the total tax levy. Of the 1923 total tax levy, amounting to $24,821,036, the mining companies pay $17,251,911. The total valuation of the county is estimated at $368,732,310, with the valuation of the iron-ore properties placed at $264,201,236 of this amount. The valuation of the mining companies is subdivided on a basis of $253,381,441 for real property and $16,474,168 for personal property.

Trojan Will Resume Development of South Dakota Gold Property

ANNOUNCEMENT is made by C. E. Dawson, general manager of the Trojan Mining Co., that work will be resumed at the company's property in the Bald Mountain district, in the Black Hills of South Dakota, as soon as weather conditions will permit. The Trojan was compelled to cease operations in March, 1923, because of high operating costs. Formerly operations showed a profit from the ores milled, but it now requires a higher-grade material to assure successful operations, and the development work will be done in the hope of opening bodies of higher-grade ore. Work will be started at the Two Johns mine.

London Letter

By W. A. Doman
Special Correspondent

London, Jan. 10—To explain the expenditure of £257,000 to which the Rhodesia Broken Hill Development Co. is committed, the directors have issued a short report made by Ross Macartney, on the progress of mine development and new construction. The document is interesting, and is illustrated. As a rule the public fights shy of illustrated documents; they savor too much of the wildcat breed, but the Rhodesia Broken Hill Co. is so favorably known—the Central Mining & Investment Corporation was associated with it for some time—through Edmund Davis, chairman, and H. J. Speak, of Hooper, Speak & Co., consulting engineers, that the pictures are welcomed.

Pilot Plant in Rhodesia Does Well

Shareholders generally do not pay much attention to the nature of the ore being treated so long as operations are remunerative, but some of them know the difference between oxidized and sulphide ores. In the case of Rhodesia Broken Hill the oxidized ore is approaching exhaustion and sulphide has to be treated. Fortunately, the sulphide ore is high in lead content, and a small experimental mill at work for nine months has produced monthly 200 tons of concentrates of 65 per cent lead. This is regarded as proof that a commercial plant will be equally successful. A concentrating and desulphurizing plant is estimated to cost £65,000. Down to the 225 level the metal contents of the ores known to exist are: zinc, 188,000 tons; lead, 68,000 tons; vanadium pentoxide, 7,700 tons. As zinc bulks so largely at present, a pilot plant for the production of zinc and vanadium, at the rate of one ton of zinc daily, has been ordered and, erected, is to cost £42,000. To provide for the extension of operations, machinery for the hydro-electric scheme on the Mulungushi River, 35 miles from

the mine, to cost £150,000 has been ordered, and should be put into operation early in 1925.

One Government Subsidy That Helped

Clearly, the Federated Malay States Government made a good bargain when it decided to relieve the tin producing companies of their outputs during the dull period, in order that the mines should be kept in operation. It is announced that a total of 4,500 tons of tin has been disposed of, and as the price is substantially higher than when the arrangement was made, nearly twelve months ago, the F. M. S. Government has a fairly big surplus, which is being applied toward the reduction of loan indebtedness.

East Rand-Cinderella Again?

On more than one occasion a rumor has been circulated that the East Rand Proprietary Mines and the Cinderella Consolidated would amalgamate, and on each occasion a denial has been forthcoming. The story is again sent from South Africa that a fusion is within measurable distance, but so far no official information can be obtained. Both companies have large capitals, and the earnings of the East Rand Proprietary are being utilized for the reduction of the debentures. There is one underground connection between the mines, and if a capital reorganization with a very big "cut" could be arranged, there is no reason why the two properties should not be jointly worked with satisfactory results.

Low Copper Price Shuts Down Humboldt Smelter, in Arizona

Officials of the Southwest Metals Co. have announced that the smelting plant at Humboldt, Ariz., will be closed on Feb. 1. The suspension of work will compel the dismissal of about 200 men. This is the first shutdown of importance in the Arizona districts that can be attributed to the present low price for copper. Production at this smelter has been about 1,000,000 lb. of copper per month and, much of the time, more than 100 companies were numbered among its shippers. Many small mines and prospects in the northern part of the state shipped their production to Humboldt, as well as others in California and the Pioche district of Nevada. In addition to the custom ores, the Blue Bell mine, near Mayer, was operated by the Southwest Metals Co. and its output reduced at Humboldt. The officials stated that they would rather suspend operations than operate when copper is quoted below 13½c.

Scheelite on Chichagof Island

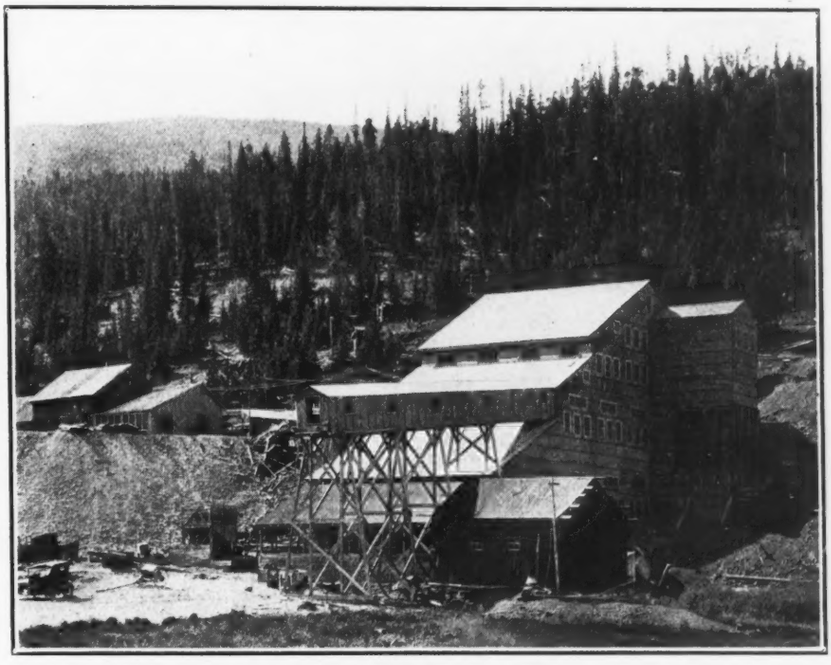
What was thought to be heavy quartz on the dump of the Jack Cann property on Chichagof Island, Alaska, has proved to be scheelite. A considerable amount is said to be available and is so situated as to make shipment easy. The real value of the material was established at the School of Mines at Fairbanks.

Royal Tiger Starts Concentrator at Breckenridge, Colo.

The Royal Tiger Mines Co., operating in the Breckenridge district, in Summit County, Colo., started its new concentrating plant early in January. About 125 tons of lead-gold-silver ore is being treated on a one-shift-per-day basis. The plant, which is shown in the accompanying photograph, besides the coarse crushing equipment, consists of rolls, jigs, tables, and flotation units. John A. Traylor is in charge of operations.

Bullionville Tailings, Shipped to Smelters, Nearly Gone

William H. Pitts, who purchased the Bullionville tailing piles near Pioche, Nev., from the Prince Consolidated Mining Co., has arranged a contract for the shipment of 30,000 additional tons to the American Smelting & Refining Co. Six cars have already been sent out; this contract should clean up the remaining tailings, which are the residues from the treatment of the ores of the Pioche district that were milled in the early 70's.



Royal Tiger concentrator at Breckenridge, Colo., recently started. Jigs, tables and flotation cells are used

Fire Destroys Million-Dollar Ore Dock

The big No. 2 iron-ore dock of the Chicago & Northwestern R.R. at Ashland, Wis., was almost destroyed by fire on Jan. 16. The loss is estimated at $1,000,000. More than 400 ft. of the dock was burned before the fire could be checked, and it was with great difficulty that it was prevented from spreading to the adjoining docks, No. 1 and No. 3. The dock was undergoing repairs at the time, and it is believed that the conflagration was started by sparks from an acetylene torch which was being used to cut up old plates in the pockets. A strong wind spread the fire rapidly. It is expected that the dock will be rebuilt as soon as possible, but definite plans have not been announced. The repairs which were being made on this dock had been estimated to cost $125,000, and a considerable part of this work had been finished at the time the fire started. This dock, together with the other two owned by the same railroad, handles about 80 per cent of the ore from the Gogebic Range. The remainder is handled at the dock of the Chicago, Milwaukee & St. Paul R.R.

Two Die in Anita Shaft Near Lordsburg, N. M.

A shaft accident caused the death of two miners at the Anita No. 2 mine, near Lordsburg, N. M., on Dec. 28. A working platform which had been placed across the main shaft at the 210 level gave away, evidently due to caving ground. Upon it at the time were three miners and the superintendent, Carl F. Schaber. Two of the men fell with the platform, a distance of about 100 ft. and were instantly killed. The other miner and Mr. Schaber escaped by a miracle. The coroner's jury made a careful examination of conditions and gave a verdict pronouncing the accident unavoidable, absolving the superintendent and the Anita Copper Co. of neglect. The property where the accident occurred is an old one and an effort is being made to clean out and pick up a badly caved shaft. Mr. Schaber, who has only recently taken charge of the operations, is an experienced miner and known to be careful and conscientious in caring for his workmen. The company recently transferred activities from the Octo mine in the expectation of getting shipping ore more quickly.

Humboldt Mining Co. Opens Old Silver-Copper Property in Mexico

Shaft Will Connect with Adit—Road and Power Plant Built—Eighty Natives Carry Heavy Machinery —Mine Development Progresses

By Henry Mace Payne

THE Humboldt Mining Co., which began development work near Ixtlan del Rio, Nayarit, Mexico, in November, 1922, now has a crosscut adit driven 1,094 ft., and has already cut one copper vein and three silver veins. A shaft is now being sunk at the back of the mountain, in the Humboldt vein, which will intersect the adit at a depth of 200 ft. This point was selected because it marked the minimum cover over the tunnel.

An 80-manpower "truck" carried heavy machinery to the Humboldt property

An automobile road has been built from the mine to Ixtlan del Rio, which will be the shipping point, on the completion of the Sud Pacifico de Mexico. Until that time, smelter ore is to be shipped by pack mule to San Marcos, Jal., on the National lines. The construction of the automobile road, 10 miles in length, occupied three months, and cost $450 per mile. This was only possible because of the plentiful supply of labor at from 37½c. to 75c. per day. The maximum grade is 4 per cent. When railroad service has been established to Ixtlan del Rio, the mining company plans to install trucking service from the mine to a warehouse to be built alongside the railroad yards.

Heavy Machinery Installed

While the construction of the road was in progress, the engine and compressor and other power-plant equipment arrived at Ixtlan del Rio. It was hauled to the end of the constructed part of the road by eight-mule teams, from which point everything was carried slung on poles and carried by Indians. Much of the equipment was specially packed with this in mind, but the flywheels, compressor base, and engine base presented much difficulty.

The engine base as a unit weighed 4,200 lb. To transport this up the old trail to the site of the power house at an elevation of 6,000 ft., two pine trees were cut and scarf-jointed. The engine base was then slung by chains and ropes, below this beam, while transversely were lashed twenty "palancas" or cross-poles, each about 8 ft. in length, providing room for two men on each side.

The eighty men chosen for "motive" power were then graded as to height, the taller men being placed on the downhill end of the beam. At a given signal the eighty men rose as one, and proceeded up the rough trail. At intervals of about 200 ft. a short rest was taken, and every hour a fifteen-minute intermission was allowed. In this manner, in about seventeen hours, the ascent was completed. The steepest of the trip was made by moonlight, when climatic conditions were much more favorable than in the broiling sun of a tropical dry summer day.

To safeguard the water supply for the camp, a strong flow of water from a point near the top of the mountain was traced back into the rock, and an underground reservoir cemented up and sealed with a locked iron door in the top, thus preventing all contamination from outside sources. This water has been found under analysis to be free from arsenic and otherwise of exceptional purity. In addition there is a strong flow of water from the tunnel, which continues even during the dry season.

Arrangements are now being made to continue the crosscut tunnel through two other silver veins, and a second copper vein, all within a distance of 350 ft. from the face, and to complete the connection of the shaft with the tunnel, which will then afford automatic ventilation. Ore tests will be carried on to determine the type of concentrating mill best adapted to the variety of ores, and it is expected that work on the construction of the mill itself will begin during the present year.

Ore Rich in Silver

Smelter shipments of ore from the three silver veins now under development indicate a general average of 46, 58, and 63 oz. of silver per ton respectively, with small quantities of gold, no lead, and little copper. The Humboldt vein shaft, referred to above, is being sunk in the vein, which averages 25 in. wide, and assays from 451 to 1,021 oz. silver per ton.

It is estimated that when developments are completed, a general run of silver ore will average between 40 and 70 oz. per ton, from the Humboldt vein, and from 14 to 30 oz. per ton from the other veins. Two copper veins have not yet been developed. The existence of these veins, the increase in values which have so far been found at lower depths, and the large number of "antiguas" which are found all over the mountain, indicate a sufficient tonnage of high value to warrant additional equipment and the early installation of the concentrating mill. The backs average 600 to 1,800 ft., with an average of 1,200 ft. There are also two adjoining properties now under option to the company, which it is proposed to acquire and merge into one holding.

A second view of freighting operations with the "engine" going

An old Spanish arrastre is found on the property, in excellent state of preservation, and near by are the ruins of an old smelter, presumably in use at the same time. In the process of removing the accumulated debris of four

centuries from the smelter, a piece of rich matte was unearthed. In several instances where the old works have been encountered, old tools have been found lying on piles of ore broken down and in some cases sorted. It is apparent that work was suddenly stopped and abandoned. These old operations rarely extend over 65 or 70 ft. in depth, but serve in almost every case to indicate the presence of high-grade ore.

Easy Bird Will Be Reopened

The Easy Bird mine, at Mokelumne Hill, Calif., has been taken over recently by the Union Gold Mining Co., of Los Angeles, from the Pacific Gold Mining & Milling Co. Local reports indicate that work will be concentrated upon sinking the present shaft from the 300 to the 600 level. A new hoist will be installed.

Alleghany-Grass Valley District, in California, Is Busy

Local reports credit the Senator W. A. Clark interests, of Montana, with the purchase of the Tightner mine, at Alleghany, Calif. The mine has been operated under option for two years, and a recent payment completed the purchase of the property. The shaft of the Gold Mound mine now being opened by the Tonopah North Star Co., in the Grass Valley district, is being unwatered. The Umatilla shaft of the Umatilla Co., of Tonopah, has reached a depth of 100 ft. The Ben Hur Co., which is reopening the Ben Franklin property, has put its stamp mill in condition for operation, and it is expected that milling will be resumed in the near future.

Eagle Shawmut Will Sink Deeper; Tonopah Belmont Out

The Eagle Shawmut mine, near Chinese Camp, Calif., which was held under option since February, 1917, until recently by the Tonopah Belmont Development Co., of Nevada, and has since reverted to its original owners, will be continued in operation. O. McCraney, who was superintendent under the Tonopah Belmont régime, will continue as superintendent. The main shaft of the property will be sunk deeper and new levels developed. A flotation concentrator and a plant for the treatment of concentrate to produce gold bullion are part of the equipment of the property.

Nevada Mine Operators Need One-third Less Cyanide

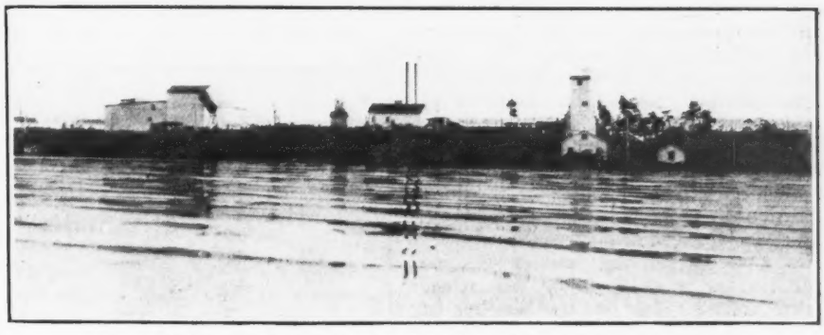
The Nevada Mine Operators' Association, through its secretary, Henry M. Rives, has closed its yearly contract for cyanide with the American Cyanamid Co. Requirements for 1924 are estimated as 1,050 tons of 100 per cent material, which is about 500 tons less than consumption during 1923. The reduction is due to the low price received for silver.

Night Hawk Peninsular Completes Mill

Ontario Gold Mine Equipped with Modern 200-Ton Plant—"Grief" Overcome and Operation Nears Capacity —Description of Plant

By J. C. Murray

THE Night Hawk Peninsular Mines, Ltd., of Ontario, has just started its 200-ton mill and cyanide plant and is rapidly bringing it up to capacity. The property lies on a peninsula running into the north end of Night Hawk Lake. The nearest railway station is Connaught, 11 miles north on the Timmins branch of the Temiskaming & Northern Ontario Ry. Connaught is 10 miles from Porquis Junction and 23 miles from the relatively metropolitan town of Timmins.



New Night Hawk Peninsular cyanide plant in the Porcupine gold district in Ontario

Eight claims, originally staked in 1907, form the nucleus of the company's holdings, which now aggregate 880 acres, including "sub-aqueous" leases. Work was begun on the property in the winter of 1916-17 by the Bonbright interests, of New York. After a shaft had been sunk to a depth of 80 ft., and a little drifting done on what is now named No. 1 vein, the property was abandoned. In 1920, A. R. Globe, who had until that time been identified with the Hollinger as assistant manager, acquired the property for the present owners. The Peninsular is the only producing mine in the Night Hawk region; in fact it is the only property that has been developed past the prospect stage.

Quick Construction Job

The new mill, recently put into operation, was completed in November, 1923. As ground was broken in June, no time was lost in erection. The mill frame is built on concrete walls. The rough board sheathing of the mill is covered with asbestos siding and hair-felt.

The building is L-shaped. In the leg of the "L" are housed the first bin, the storage tank, and the first grinding unit. In the main body of the building is the cyanide department. The addition of new units will give the mill a rectangular shape.

As bedrock is covered with 25 ft. of clay, the foundations of tanks and of all heavy equipment are set on reinforced concrete pads. Nearly all the tank foundations are of the filled wall type.

From the following outline of ore treatment it will be seen that normal Porcupine practice has been followed and that no tempting innovations are being introduced.

Counter-Current Decantation

After grinding in cyanide solution in closed circuit with a classifier, the classifier overflow is lifted by bucket elevator (a sand pump is provided for emergency duty) to a primary thickener. The thickener overflow goes to a "muddy" gold sump classifier and vacuum filter and is precipitated by zinc dust in conjunction with the Crowe vacuum process. The thickened pulp discharge of the primary thickener is given a twenty-four-hour agitation in three steps. This treatment is followed by four-step counter-current decantation, which is accomplished in two closed-type tray thickeners. The last overflow is wasted. The overflow from No. 1 is used as mill solution.

The ore as it comes from the mine is passed over a grizzly. The oversize is crushed to approximately ½ in. in a 12x20-in. Buchanan crusher. The crushed oversize and the undersize from the grizzly meet on a 14-in. conveyor belt, which feeds at an angle of 22 deg. to a conical bottom bin of 400-ton capacity.

Grinding is at present done with one 8-ft. x 36-in. Hardinge mill, which is in closed circuit with a bowl-type Dorr classifier.

No attempt is made to produce a high-grade bullion. The precipitate, after being dried in presses, is fluxed and melted in a tilting furnace.

The power used, hydro-electric 60 cycle, is supplied by the Great Northern Power Co. The total mill requirements are 295 hp. The mill was planned and designed by Mr. Globe in collaboration with Noel Cunningham, consulting metallurgist, formerly on the staff of the Hollinger.

New Machinery and Inventions

Experimentation in Filtering Leads to Improvements

Work Extends in Blast Furnace Field and Cyanidation—An Acid-proof Fabric Desirable

Results obtained in the blast-furnace field with the American filter during 1923 are dealt with in a report issued by the United Filters Corporation. The essential features of the work of recovering blast furnace flue dust are given in it.

A study of the possibility of substituting what may be termed "counter-current filtration" as an improvement on counter-current decantation methods in the cyanide industry has been made by one of the company's staff. This consists in arranging the desired number of American filters in series in such manner that the cake discharged from the first enters a suitable mixing tank where it is puddled with dilute solution and fed to the second unit. This, in turn, discharges the residue into a second mixing tank, which repuddles the mixture to be fed to the third unit, and so on, the number of units depending upon the strength of solution, percentage of solids, and other and minor factors. While the discharged residue progressively passes from one filter to another, the solution, which was either barren solution or plain water as it entered the last of the series of filters, is progressively transferred from one unit to the other in the opposite direction to the line of travel of the pulp. The result of this method is that the residues diminish in their dissolved content of precious metal with each successive step, while the solution traveling through the series in the opposite direction increases in strength and value with each operation until it emerges from the first filter of the series as a comparatively strong pregnant solution ready for the precipitation department, through which it is passed and then returns to the same path as before. This system offers interesting possibilities for material improvement over counter-current decantation, the company claims.

Further developments and improvements have been made in the construction of acid-proof Sweetland filters as well as in acid-proof American filters to keep step with the more complicated metallurgical processes now in vogue. In the last few years there has been extensive development in the manufacture of acid-resistant alloys. Some of these possess excellent qualities of resistance to acid action, and the development work accomplished gives promise of facilitating the construction of acid-proof apparatus, but there is still a need for a filter fabric which is resistant to acid action, the company states. This seems to be the greatest bugbear in the development of acid-proof filters, and indeed it is of so much importance that the invention of a thoroughly satisfactory acid-proof filter fabric which could be sold at a reasonable figure would greatly promote metallurgical and chemical development in general. This is a field that would seem to be well worthy of the attention of the inventively inclined.

Inclosed Grinders Practical for Mine Shops

Grinders that are totally inclosed are useful for mine shops where there is much fine dust. The operating mechanism of such grinders is thus

Totally inclosed grinder with push-button control

thoroughly dust-proof. The machine shown in the cut is mounted on a pedestal so designed as to give a large clearance with a short spindle extension. Switches of the push-button type or snap type are mounted so as to be easily reached by the operator. A tendency of modern shop practice is to eliminate belting wherever possible. The grinder shown can be easily moved from place to place as needed. Due to the contour of the inclosing shell it is easy to keep the machine clean. This type of grinder is made by the Electric Co., Cincinnati, Ohio. It may also be had with a water pocket built in the pedestal.

Nordberg Will Make New Type of Ball Mill

Manufacturing and sales rights for a new type of ball mill known as the Fairchild double-discharge ball mill, invented by Donald H. Fairchild, of Chicago, have recently been acquired by the Nordberg Manufacturing Co., of Milwaukee. B. V. E. Nordberg, executive engineer for the Nordberg company, and Mr. Fairchild are now in Arizona for the purpose of discussing with mine operators in the Southwest the use of these mills.

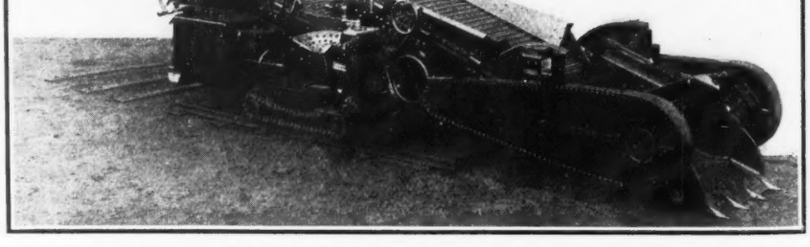
These mills are expected by the inventor to produce a minimum of 50 per cent more tonnage from any given floor space than any other mill and at the same time to reduce power and steel costs appreciably as well as affecting other cost items. The Fairchild mills are a radical departure from the regular or standard types and their design is such as to make possible a compact and efficient flow sheet.

An Underground Shovel for Low Headroom

Announcement of the production of a special No. 3 size shovel for use in low headroom has recently been made by the Myers-Whaley Co., of Knoxville, Tenn. This new shovel requires only 48 in. from rail to roof when in operation, and its over-all height is 45 in. The height from the rail to the top of the conveyor belt is 41½ in., the shovel reach is 8 ft. to each side of the track center, and the rear conveyor is adjustable laterally to load on curves or on parallel track. The machine has weight and strength to do the hardest kind of rock loading. Its construction is first class in every particular. It will handle more than a ton a minute and carries a guarantee to average three-quarters of a ton per minute.

While this machine is especially adapted to any kind of loading in a coal mine, it is applicable also to other kinds of mining, as it, like all other shovels of the same make, is built to handle the heavier ores and rock.

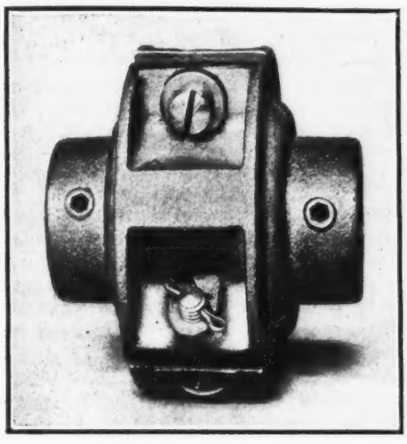
The development of this size of underground loading machine to meet low headroom conditions is one of the achievements of the past year in the design of new machinery. Mechanical shovel design made marked advance in 1923.



This underground loading machine will work in places where roof is only 48 in. above the rail

Flexible Coupling for Power Transmission Shafts

A coupling for power transmission shafts that is strong and durable and at the same time flexible and adaptable has recently been developed. The hubs are fitted to the shafts by keys in the usual way. Each hub is finished all over and has a triangular-shaped face to form three projections or teeth. A housing made in three pieces incloses the teeth and serves to transmit the power from one hub to the other somewhat after the manner of an internal gear. The joint between each housing is made by means of a bolt fitted with a locknut and carrying leather washers at each end to provide flexibility. A dowel pin is also provided at each joint.



A flexible coupling that is strong and durable

The degree of flexibility depends to some extent upon the tightness with which the bolts are fitted, although the shocks are absorbed by the ability of the housing to expand. Further flexibility is given by the insertion of a piece of steel-faced automobile brake lining in each housing to cover the acting portion of the tooth. The lining takes the shock and makes the action of the coupling noiseless.

End play is permitted by making the inside of the coupling somewhat wider than the width of the two teeth. Both angular and parallel misalignments of the center lines of the shafts are permissible. The coupling is intended to operate under practically any conditions of speed or duty, to transmit power up to the capacity of the shafting. The tooth surfaces are lubricated by grease, which the action of centrifugal force tends to throw to the tops. The housing is dust proof and grease-proof, because of the packing, which is placed at each joint of the housing and at each side of it next to the hubs. Both hubs are duplicates and the three parts of the housing are alike, so that the parts can very easily be kept in stock.

A coupling having a bore 1 in. in diameter has an outside diameter of 5 in., an over-all length of 3½ in. without considering the end play, which is ¼ in. The weight is 6 lb. The new coupling is the invention of Charles H. Clark, 60 Church St., New York.

Line of Crushing Equipment Extended

Two machines have been added to the line of the Traylor Engineering & Manufacturing Co., of Allentown, Pa., in the last year. One is the Bulldog gyratory finishing crusher. These crushers will produce large quantities of ¾-in. to 1½-in. material from 5 to 9-in. feed, it is claimed. The concaves in this crusher are set vertically and are held in place by a key and wedge concave that is bolted through the outer shell. These concaves being set vertically, it is possible to reverse them end for end without disturbing or dismantling the crusher in any way other than to change the concaves. This feature, it is claimed, results in the wearing out of the concaves at both ends and also permits the product of the crusher to be kept at a more uniform size.

The shafts, spider, eccentric, and other parts that are subject to great strain are said to be the largest ever designed in a gyratory crusher of the sizes in which this finishing crusher is built—namely, 6 in. and 10 in. The great strength of these machines permits them to be operated continuously and with a full feed. Even though buried, they will ultimately clear themselves at the end of the day's run.

Another addition to the company's line is the Ajo-type crushing rolls. These rolls are of very massive design, with two large tension rods, one above and one below the bearings on either side of the machine. These bearings are solid, self-aligning, and dust-proof. The shafts are said to be the largest ever installed in any type of crushing roll manufactured. The spring pressures are 30,000 lb. per inch of roll face. The frame, owing to limitations of shipping facilities on western railroads, is necessarily split, but is securely bolted and keyed together when erected. The pulleys are of plate construction of the flywheel type, with both rolls having the same diameter and face of pulley, thus delivering to each roll an equal amount of power.

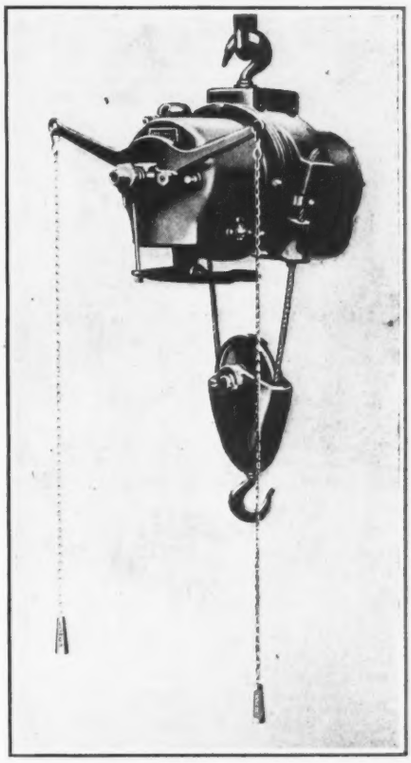
Portable Electric Instruments Described in New Bulletin

Direct-current portable instruments made by the Roller-Smith Co., of Bethlehem, Pa., are described in Bulletin No. 210, issued by the company in December. The line covered by the bulletin includes ammeters, milli-ammeters, voltmeters, milli-voltmeters, volt-ammeters, galvanometers, shunts and multipliers. All direct-current portable instruments made by the company are described except small sizes and instruments for signal system testing, which are listed in other bulletins. Apparently there is an instrument for every need in the wide variety of types and ranges.

A New Air Motor Hoist for Handling Small Loads

An air motor hoist of small and compact construction has been developed by the Ingersoll-Rand Co., 11 Broadway, New York. This is the size A hoist which has a capacity of 500 lb. It is suited for a wide range of service and is smaller than any air motor hoist previously manufactured. It is useful wherever rapid and economical handling of small loads, too heavy for one man to deal with, is desired.

The outstanding characteristics of the new hoist, as described by the maker, are briefly as follows: Compactness of design, necessitating only low head room; relatively light weight; automatic brake which positively holds the load under all circumstances—even if the air supply be disconnected or fail; and a graduated throttle which permits a very close regulation of both the lifting and the lowering speeds. A balanced three-cylinder air motor is used, which operates in either direction and without vibration at any speed or load within the rated capacity of the machine. Some of the advantages of this motor are its freedom from vibration, the ready manner in which it can be throttled down slowly at all loads, and the absence of lubricating troubles.



Air motor hoist of 500-lb. capacity, for wide range of service

The hoist is entirely distinct from direct-acting cylinder hoists and lifts. The latter consist essentially of only the plunger and a case. On the other hand it is equipped with a high powered and efficient air motor which is geared through a mechanical train to a hoisting drum. A safety stop lever is provided.

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
17	12.20	48.50	49.00	8.00	8.00	6.40@6.45
18	12.25	48.625	49.125	8.00	8.00	6.45
19	12.25	49.25	49.75	8.025	8.00@8.10	6.45
21	12.25 @12.375	48.875	49.375	8.025	8.15@8.25	6.45
22	12.375@12.50	49.50	50.00	8.025	8.175	6.45@6.50
23	12.375@12.625	50.50	51.00	8.025	8.10@8.15	6.50
Av.	12.325	49.208	49.708	8.017	8.092	6.458

*These prices correspond to the following quotations for copper delivered: Jan. 17th, 12.45c.; 18th and 19th, 12.50c.; 21st, 12.50@12.625c.; 22d, 12.625@12.75c.; 23d, 12.625@12.875c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
17	60 3/8	61 1/8	66 1/2	248 3/4	250	32 1/8	31 7/8	35 1/4	34 5/8
18	60 5/8	61 1/4	66 3/4	250	251 1/2	32 1/8	32 1/4	35 3/8	34 7/8
21	61 3/8	62 1/8	67 1/4	252 1/8	253 3/8	32 1/8	32 1/8	35 5/8	34 7/8
22	62 1/8	62 7/8	68	250	251 1/2	32 1/8	32 1/8	35 7/8	34 7/8
23	62 1/8	62 7/8	68	254	255 1/4	32 1/4	32 1/2	35 7/8	34 7/8

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver		Gold London	Jan.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
17	4.24 3/4	63 1/8	33 1/2	96s 11d	21	4.21	63	33 11/16	98s 0d
18	4.23 3/8	62 7/8	33 1/2	97s 5d	22	4.22	63 1/2	33 7/8	97s 11d
19	4.23 1/8	62 7/8	33 1/2	...	23	4.21 1/2	63 1/4	33 3/4	97s 6d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Jan. 23, 1924

For the first time in some weeks, all of the non-ferrous metals have advanced in price, and producers and sellers are optimistic. The European situation looks better than for some time, and also metal consumers in this country are anticipating an excellent spring business.

Copper

The market dragged along at substantially unchanged prices and with little interest manifested until Saturday, when a large number of inquiries developed. These resulted in substantial business being placed on Monday, which absorbed all the metal that was offered at 12¼c. delivered. Also, on that day, several lots were sold at 12⅝c. Yesterday, copper was quite freely obtainable in some quarters at 12⅝c., but some sellers had advanced to 12¾c., at which level an important tonnage was booked, though we have reason to believe that the total was nothing like the 20,000,000 lb. reported on the tickers. At the close of business yesterday, a little business was placed in the East at 12⅞c., but this was an outside price. Today the market is even stronger, but at least one seller has a little available at 12⅝c.; the general price level may be said to be 12¾c. There seems little demand for prompt deliveries, most of the copper sold being for February to April shipment. Though the situation looks much better, producers have been by no means swept off their feet, inquiries being much more numerous than actual orders.

Export demand has also picked up in the last day or two, and it is said that 12¾c., f.a.s., is about the best that could be done today. France, Germany, and Scandinavia were all buyers yesterday.

Lead

The official contract price of the American Smelting & Refining Co. was advanced from 7.9c. to 8c. on Friday, Jan. 18.

Demand for lead continues excellent, though most of the business has been on a contract basis. Consumers, in general, seem disposed to take pretty close to their maximum allowances. The cable and battery business is active. Prices asked for spot lead continue considerably above the general market, as high as 8¼c. being currently reported, but these figures are almost entirely nominal. Most of the business has been done by the principal producer at its established level. In the Middle West, the market seems to have been a little quieter in the last day or two. On Monday, as high as 8.25c. St. Louis was paid for January shipment, but nothing earlier than February now seems to be in demand, and there would be no difficulty in obtaining such lead at 8.15c. today, although not from all producers, some asking 8.20c. The Chicago price seems to be even less than that obtaining at St. Louis.

No weakness is yet apparent in the lead situation, despite high prices. The advance in London indicates that that market cannot get along with part of its supply from Mexico diverted to this country, as has been the case recently. Production, too, seems to have been increased about as much as possible without important enlargements in mine and smelter capacity. On the other hand, no immediate scarcity of lead is apparent, for consumers are already pretty well taken care of for their requirements up to the end of February.

Zinc

Zinc has been in fair demand during the week at gradually increasing prices. Export business has been done, the local quotations being substantially on a parity with the London market. Galvanizers have been the chief buyers, though more interest is expected on the part of brass makers, now that copper

buying is picking up. High-grade continues unchanged at 8@8½c. delivered.

Tin

Tin continues to advance, the 50c. level now apparently being well established. Spot metal is exceedingly scarce and promises to remain so during the rest of the month.

Arrivals of tin, in long tons: Jan. 16th, Straits, 50; Liverpool, 210; 18th, Australia, 50; 21st, Straits, 800; China, 50; 22d, Rotterdam, 55. Total so far in January, 2,775.

Foreign Exchange

Foreign exchange continues unsettled. On Tuesday, Jan. 22, cable quotations on francs were 4.58c.; lire, 4.355c.; and Canadian dollars, 2 7/16 per cent discount.

Silver

The market has been mainly supported by inquiries from India until the last two days, when special demand from China helped to support prices, bringing the London official up to 33⅝d. The market closes a little easier today.

Mexican Dollars—Jan. 17th, 48⅛; 18th, 48; 19th, 48; 21st, 48; 22d, 48⅜; 23d, 48¼.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28¼c. per lb.; 98 per cent, 27½c. London, £115 per long ton.

Antimony — Chinese and Japanese brands, 10¼@10½c. W.C.C. brand, 11½@12c. Cookson's "C" grade, 12@12½c. Chinese needle antimony, lump, nominal, 7½@8½c. per lb. Standard powdered needle antimony (200 mesh), 8@9c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 8@8½c.

Bismuth—$2.30 per lb. London, 10s.

Cadmium—75@80c. per lb. London, 2s. 6d.

Cobalt—$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—26@30c. per lb. for 99 per cent virgin metal. London, £130 long ton.

Palladium—$83 per oz.

Platinum—$122 per oz. London, £29. Crude platinum, $117 per oz.

Quicksilver—$58@$60 per 75-lb. flask. Quiet. San Francisco wires $59.65. London, £9 15s.

The prices of **Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium,** and **Tungsten are unchanged from** prices given Jan. 5.

Metallic Ores

Chrome—$19.50@$22, depending upon grade and source. Nominal.

Manganese — 42@44c. per long ton unit, seaport, plus duty. Nominal.

Molybdenum—80c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Rutile—Granular, 94 to 96 per cent TiO_2, 12@15c. per lb.; pulverized (100 mesh) 94@96 per cent TiO_2, 17@30c. per lb.; f.o.b. Virginia points. Market limited but growing. Special contract prices for long periods given.

Ilmenite—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. Virginia points.

Tungsten Ore—High-grade wolframite, $9; high-grade scheelite, $9.50@$10 per unit. Ordinary grades, $8.25@$8.50.

Iron Ore, Magnetite, Tantalum, Vanadium, and **Zircon Ore** are unchanged from Jan. 5 quotations.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 19—Zinc blende, per ton, high, $45.95; basis 60 per cent zinc, premium, $44@$45; Prime Western, $43@$44; fines and slimes, $42@$40.50; average settling price, all blende ores, $42.83.

Lead, high, $112.60; basis 80 per cent lead, $110@$115; average settling price, all grades of lead, $106.95 per ton.

Shipments for the week: Blende, 11,600; lead, 1,198 tons. Value, all ores the week, $624,880.

Zinc prices were generally advanced $1 per ton, and late today lead was hovering between buyers' offerings of $112.50 and sellers' demands of $115, with no stocks of lead and a limited production.

Severe winter weather has prevailed the greater part of the week, with zero temperature, snow, then rain, covering the entire district tonight with a glaze of ice, and colder weather is promised for tomorrow.

Production is lowered to approximately 12,000 tons per week, with this week's purchases 12,830 tons.

Platteville, Wis., Jan. 19—Blende, basis 60 per cent zinc, $46 per ton. Lead, basis 80 per cent lead, $112 per ton. Shipments for the week: Blende, 726 tons; lead, none. Shipments for the year: Blende, 2,014; lead 40 tons. Shipments for the week to separating plants, 918 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $325@$450; No. 2, $200@$250; spinning fibers, $100@$125; magnesia and compressed sheet fibers, $60@$90; shingle stock, $50@$70; paper stock $30@$40; cement stock, $17@$20; floats, $6@$12. **All f.o.b. mines, per short ton, Quebec.**

Barytes—Crude $8.50 per ton, f.o.b. mines, Georgia.

Graphite—Amorphous crude, $15@$35 per ton. Other quotations in Jan. 5 issue.

Bauxite, Beryl, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and **Tripoli** are unchanged from the Jan. 5 prices.

Mineral Products

Arsenious Oxide (white arsenic)—13½c. per lb.

Copper Sulphate—4.65@4.75c. per lb. Quiet. Imported supplies now absorbed.

Potassium Sulphate, Sodium Sulphate and **Sodium Nitrate** are unchanged from the Jan. 5 prices.

Ferro-Alloys

Ferrochrome—1 to 2 per cent carbon, 30c. per lb.; 4 to 6 per cent carbon, 10¾c. per lb.

Ferromanganese — Domestic, 78@82 per cent, $109 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $38@$40, f.o.b. furnace; 16@19 per cent, $37@$38.

Ferromolybdenum—$2@$2.50 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $41.50 @$46.50 per gross ton, f.o.b. works; 50 per cent, $75 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten—85@90c. per lb. of contained W, f.o.b. works. Quiet.

Ferro-uranium—35 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium — $3.50@$4 per lb. of V contained, f.o.b. works. Active.

Metal Products

Copper—Sheets, 20.50c. base; wire, 15½c.

Lead Sheets—Cut, 10.50c.; full, 10.25c. per lb.

Nickel Silver—18 per cent Grade A sheets, 26.75c.

Yellow Metal — Dimension sheets, 18.25c.; rods, 15.25c.

Zinc Sheets—Base price, $9.50 per 100 lb., f.o.b. plant.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and Zirkite are unchanged from the Jan. 5 prices.

The Iron Trade

Pittsburgh, Jan. 22, 1924

A fair volume of business is being done in all the regular steel-mill products. All lines of steel-consuming activity are reasonably busy, except that there is little activity in railroad rolling stock.

Steel prices continue to be well held, but buyers are trusting the market only as far as they can see it.

Pig Iron—There is little inquiry from consumers. Scrap dealers are said to be bidding for basic pig iron, producers being reluctant to sell to dealers. Heavy melting steel scrap has sold at $22 delivered Pittsburgh district, and $23 delivered Youngstown district, or at the highest price relative to pig iron ever attained. Basic is predicted to advance, but remains quotable at $21, Valley, in the absence of definite movement. Bessemer remains at $23, Valley. Foundry, at $22@$22.50, Valley, shows a distinct leaning toward the higher figure.

Connellsville Coke—All furnaces seem to be covered for the quarter and the spot market is narrow, almost nominal, at $3.75@$4. Spot foundry remains at $5@$5.50.

German Metal Consumption Improving

Keen American Competition Gives Copper Manufacturers Cheap Metal—Taxes in Ruhr Affect Demand

SPECIAL FOREIGN CORRESPONDENCE

THE German metal trades, a long time in a torpor, have now undoubtedly turned the corner. Progress is expressed in increasing metal consumption. Within a period of six weeks or so the rate of copper consumption has jumped from 3,500 metric tons to 8,000 tons a month, and this has been and is being stimulated by some important factors. The stability of the new intermediate currency, the rentenmark, is one of these factors. London dealers find that it pays to sell below London official quotations to Germany because the depreciation of the pound sterling by 5 per cent against the rentenmark favors such business.

The disintegration of the Berlin Kupfer-Import Co. consequent upon the withdrawal of the American Smelting & Refining Co. from the Copper Export Association and the present establishment of two different branches—one the Guggenheim branch, under the management of Mr. Koning, who, previous to the Great War was a representative of the Guggenheims, and until recently the general manager of the Kupfer-Import Co., and the other the remaining group of producers within the C.E.A. headed by Mr. Bergman—leads the copper importers to believe that a new period of copper "dumping" into Hamburg and Rotterdam, of cheap copper, is at hand.

The metal people believe that the Anaconda company disposes of low-cost Chilean production and that the Chilean metal can be carried through the Panama Canal to European ports with hardly any higher freight charges than when sent to New York. On the other hand, the Guggenheims control many efficient mines and are able to stand competition with the Rockefellers, so that the European consumer is the one to benefit the most. Although Mr. Koning and Mr. Bergman flatly deny any alleged desire to lead a crushing scramble of the producers for business, people are convinced that the copper slump has not reached bottom, especially in view of increasing activity of the Nichols Copper Co., the result being that New York f.o.b. quotations are underbidden here in the open market by a fourth of a cent per pound for prompt delivery. All of this tends to increase the demand for the red metal in Germany, a country that once more bids fair to become a most important outlet for copper. Her rôle would be far more brilliant were not customs duties to be paid to the Mission Interalliée of Düsseldorf stupidly high for goods entering into the unoccupied Germany or exported into foreign countries from the Ruhr and Rhineland. The extra duty, say, for cable is 6½ per cent *ad valorem*, so that the export of this and other manufactures cannot be effected without much trouble by the metal manufacturer. In view of the vital interest of the allies in the welfare of the Ruhr industries, it seems certain that the rigid customs regulations will be alleviated ere long. Negotiations to this effect are proceeding. In that event copper orders of the influential rollers and drawers of the Ruhr will no doubt add materially to the improvement industrially, on account of the necessity of replenishing empty stocks.

The principal factors in the revival of the metal trades are two: reduced expenditures and longer hours of work in mines, mills, and plants, which counterbalance the bad effect of highly valued German currency upon foreign trade, and the elimination of the public railway and postal services from the market. As a matter of fact, fuel prices, especially those of coke, surpass pre-war prices by only 30 per cent, whereas British fuel prices are more than 100 per cent higher. The general talk is that a lowering of railway freights is imminent. Miners and other workers are laboring ten hours or more for smaller wages. The Mansfeld Copper Co. of Eislaben, the most important casting copper producer of Germany, has made a statement to its staff that on account of financial losses suffered in consequence of low copper prices, and the costly working expenditure of the last year, that capital which the firm had before the beginning of the last copper slump has been almost entirely consumed, and that therefore intensive instead of extensive work is indispensable. The Mansfeld company has had to fight communistic tendencies among its ranks of miners. Generally longer shifts are now the rule in Germany; also in the government lead, silver, and zinc mines of the Harz, Upper Silesian, and southwestern fields. Self-supply and independence of foreign deliveries is being encouraged, and for the same reason a great many mergers are under way. Some projects have for their object erection of more electrolytic plants, using brown-coal power for working up ores and old metals of the German industries, or to revive old copper, lead, and other mines. The capital is to be procured in the usual manner or by foreign participation. Such thoughts are embodied in the so-called organization Metallurgischer und Chemischer Verein Sächsen Akt. Ges., which comprises the Neue Sächsische Erzbergbau Akt. Ges. The Dutch and Swiss capitalists are much interested in the German industries, and it is hoped that the resources of the country can be developed further.

I learned from a most reliable source that the Aluminum Company of Neuhausen (Swiss) wishes to take an interest in the German aluminum industry, especially with regard to the completion of the South Bavarian Inn-Werk, which will bring German production of the light metal up to 40,000 metric tons per year. Although the difficulties of obtaining bauxite from Yugoslavia and southern France have increased, the young aluminum industry sticks to its independence of foreign influences and has so far repulsed every offer of Neuhausen.

Metal speculation, which has long been rife in Germany, has wholly disappeared, and prices are normal or even lower than abroad. The two metal exchanges of Hamburg and Berlin have taken up their official quotation work, and since quotations are on a gold mark basis again, Germany can buy metals below the pre-war level. Rentenpfennig coins consist once more of copper or aluminum bronze; iron and zinc coins no longer find any favor with the public.

El Oro Mining & Ry. Co., Ltd.

Gold; Mexico

A report of the operations of the El Oro Mining & Ry. Co., Ltd., for the year ended June 30, 1923, shows a net profit for the period of £55,228 2s. 3d., which, added to the balance of £39,074 4s. 2d. brought forward from the previous accounts, makes a total credit to profit-and-loss account of £94,302 6s. 5d. Out of this amount the directors have considered it advisable to place a sum of £30,000 to reserve against the amounts advanced to the Compania de Inversiones del Oro, S. A., as explained later, leaving to the credit of profit-and-loss account a sum of £64,302 6s. 5d.

As the equipment of the Noria Mine, referred to later herein, will entail an expenditure of roundly £110,000, the directors are unable to maintain a dividend of 1s. per share. They recommend the payment of a dividend of 6d. per share, or 2½ per cent, free of tax, which will absorb £28,687 10s., leaving a balance of £35,614 16s. 5d. to be carried forward.

During the year ended June 30, last, 399,820 tons of ore was treated, yielding $1,953,661.47, being an average recovery of $4.88 per ton, compared with 401,840 tons and an average recovery of $5.48 per ton in the year preceding. This represents an all-round extraction of the gross gold and silver contents of the ore of 86.29 per cent and compares with 86.05 per cent obtained in the previous year.

The total average working costs per ton treated, including every expense in Mexico, were $4.44, comparing with $4.79 last year. These costs include 38c. per ton for development and 62c. for state and federal taxes.

No new orebodies have been encountered, and owing to the extensive exploration carried out during past years, there is little new country left to investigate. By extraction

of bodies of low-grade ore previously left in position and pillars and re-treatment of old filling material, the supply to the mill has been kept practically up to the tonnage of the previous year. The ore available for extraction on June 30 last is stated by Mr. Main at 330,000 tons carrying $4.444 in gold and 1.69 oz. of silver.

The net profit on operations of the railway was $131,938.13, compared with $196,492.98 for last year.

During the year to June 30, 1923, the Compania de Inversiones del Oro expended further sums upon exploration and development of various properties amounting to $369,381, and the total lent to it at June 30 was $773,983.66. Of this amount directors consider that $134,134 is not represented by live assets, and they therefore think it prudent to set up the reserve of £30,000, above mentioned.

The development of the Noria property has continued to give good results, and the management of the Compania de Inversiones del Oro, S. A., has now decided to give the necessary notice of intention to take up the lease in accordance with the terms of the agreement. Plans and specifications for the necessary mill and power plant are now in course of preparation. It is estimated that the cost of installation will amount to $494,000, or roughly £110,000, referred to above, and the work will be started as soon as the plans are completed.

Mining Dividends for January Again Increase

The following dividends were paid by mining and metallurgical companies in January:

Companies in the United States	Situation	Per Share	Total
Anaconda Copper	Various	$0.75 Q	$2,250,000
Arizona Commercial, c	Ariz.	.50 SA	132,500
Bethlehem Steel	Various	1.25 QB	845,106
California Rand Silver	Calif.	.12 MX	153,600
Cleveland-Cliffs Iron	Mich., Minn.	.75	298,722
Cresson Consolidated Gold	Colo.	.10 Q	122,000
Homestake Mining, g	S. D.	.50 M	125,580
Inland Steel, pfd	Minn.	1.75 Q	175,000
Inspiration Consolidated Copper	Ariz.	.50 Q	590,983
Kennecott Copper	Alaska	.75 Q	2,090,341
Park City, s, l, z	Utah	.15 Q	131,400
Park Utah, s, l	Utah	.15 Q	150,000
Phelps Dodge, c	Various	1.00 Q	500,000
Republic Iron & Steel, pfd	Various	3.75 QY	937,500
Silver King Coalition, s, l, z	Utah	.15 Q	187,500
Sloss-Sheffield Steel & Iron, pfd	Ala.	1.75 Q	117,250
Tennessee Copper & Chemical	Tenn.	.25 Q	200,000
Tintic Standard, s, l, c	Utah	.25 QZ	293,675
Tonopah Extension, s, g	Nev.	.05 Q	69,636
United Eastern, g	Ariz.	.15 Q	204,450
U. S. Smelting, Ref. & Min., pfd., s, l	Various	.875 Q	425,556
Virginia Iron, Coal & Coke	Various	1.50 SA	150,000
Virginia Iron, Coal & Coke, pfd	Various	2.50 SA	125,000
Companies in Other Countries			
Ahumada Lead	Chihuahua	.20 I	236,000
Asbestos Corporation, pfd	Quebec	1.50 Q	60,000
Consolidated Mining & Smelting	B. C.	1.50	628,907
Dome Mines, g	Ont.	.50 Q	238,333
Erupcion, l	Chihuahua	.125	156,250
Frontino & Bolivia, g	Colombia	1 sh.	£7,000
Hollinger Consolidated Gold	Ontario	.05 4 wks.	$246,000
Howe Sound, c	B. C.	.05 Q	99,207
N. Y. & Honduras Rosario, g, s	Honduras	.25 Q	50,000
Nipissing, s	Ontario	.30 Q	360,000
Ouro Preto Gold Mines of Brazil	Brazil	1 sh.	£1,971
Premier Gold	B. C.	.08 Q	$400,000
Silversmith Mines, s, l, z	B. C.	.02 Q	50,000
Total			$12,800,496

Q, quarterly; SA, semi-annually; B, also paid 1¾ per cent on 7 per cent cumulative preferred, 1¾ per cent on non-cumulative preferred, and 2 per cent on 8 per cent preferred; M, monthly; X, includes 10c. extra; Y, includes $1 extra as cumulative dividend; Z, includes special dividend of 15c.; I, initial dividend; c, copper; g, gold; s, silver; l, lead; z, zinc.

Dividends paid by mining companies in the Americas during January again show an increase, being slightly over a million dollars greater than those paid in October, 1923, for the corresponding previous quarter. Park City increased its dividend from 12½ to 15c.; Tintic Standard made a special distribution; Ahumada entered the list of dividend payers for the first time; and Silversmith doubled its previous dividend. On the other hand, nothing was reported from Iron Blossom; Kerr Lake has decided to pay dividends only semi-annually instead of quarterly for a time; and the Asbestos Corporation has found competition so bitter that it has been compelled to pass the regular quarterly dividend on the common.

Facts for the Stockholder

XXXII—Utah Copper Co.

THE UTAH COPPER CO. was incorporated in New Jersey, in April, 1904, as a reorganization of a company of the same name incorporated in June, 1903. In 1910, it acquired the entire capital stock of the Boston Consolidated Copper & Gold Mining Co., Ltd., an English corporation which owned all the stock of the Boston Consolidated Mining Co., in exchange for 310,000 shares of Utah Copper Co. stock. Following the completion of this purchase, the English company was liquidated. The Utah Copper Co. controls the Nevada Consolidated Copper Co. through the ownership of a little over 50 per cent of the outstanding stock. It owns all of the Bingham & Garfield Ry. Co.; a little over 63 per cent of the Garfield Improvement Co.; 50 per cent of the Garfield Chemical & Mfg. Co.; the Shawmut Consolidated Copper Co.; the Pay Roll group; the Jay Gould and Alamo claims, and the Mystic Shrine group. It owns, also, numerous water rights and investments. On May 31, 1923, the Kennecott Copper Corporation owned over 75 per cent of the stock of the Utah Copper Co.

Utah Copper Co. owns 867 acres of lode mining claims in the Bingham district, and over 11,000 acres of other lands located on both sides of Bingham Canyon, Utah, and in Utah County, near Utah Lake. It has the second largest developed orebody in the world, being exceeded only by that of the Chile Copper Co. Ore reserves are estimated at 358,000,000 tons of ore, averaging 1.35 per cent copper. The primary and predominating copper mineral is chalcocite.

Development has shown that about 226 acres contain mineralized porphyry of commercial value. The orebody, as at present developed, has a maximum length of a little over one mile, and a maximum width of a little over one-half mile.

The Bingham & Garfield Ry. has trackage of over 130 miles.

Milling equipment includes the remodeled Magna plant, with a capacity of 24,000 tons daily, and the Arthur plant, with a capacity of 16,000 tons, making a total capacity of 40,000 tons per day.

Production of copper in millions of pounds per annum, has been as follows: 93.5 in 1911, 91.4 in 1912, 113.9 in 1913, 115.7 in 1914, 148.4 in 1915, 187.5 in 1916, 195.8 in 1917, 188.1 in 1918, 105.1 in 1919, 101.9 in 1920, 24.5 in 1921, 86.8 in 1922, 80.7 in first half of 1923. Mining operations were suspended April 4, 1921, and resumed April 4, 1922.

Production costs have been estimated as follows: 7.86c. a pound in 1911, 8.46c. in 1912, 8.64c. in 1913. 7.24c. in 1914, 6.61c. in 1915, 6.95c. in 1916. The foregoing figures include taxes but not depreciation. Including depreciation and all taxes, the cost for 1917 is estimated at 10.99c. a pound. Including depreciation, and all taxes except Federal income and profit taxes, the cost for the next three years was estimated as follows: 12.53c. in 1918, 12.36c. in 1919, 13.14c. in 1920. Including taxes, but not depreciation, the cost was estimated at 11.57c. in 1921, and 7.82c. in 1922.

Capital stock consists of 1,624,490 shares, par value $10. There is no funded debt. At the close of 1922, total current assets were $20,181,075, and current liabilities amounted to $3.844,105, leaving net working capital at $16,336,970. Net tangible assets applicable to the stock were estimated at about $38.70 a share.

Earnings per share have been as follows: $3.96 in 1911, $5.35 in 1912, $5.38 in 1913, $5.34 in 1914, $11.03 in 1915, $24.46 in 1916, $17.66 in 1917, $11.35 in 1918, $5.08 in 1919, $3.03 in 1920, a loss of $1.27 in 1921, a profit of $1.04 in 1922.

The dividend record has been: $3 a share in 1911-1914, $4.25 in 1915, $12.00 in 1916, $14.50 in 1917, $10.00 in 1918, $6.00 in 1919-1920, $2.50 in 1921, $2.00 in 1922, $4.00 in 1923. In 1923 a quarterly dividend of $1 per share was paid.

Price range of the stock in recent years has been: High, 130 in 1916; low, 41½ in 1921; closing price, 64½ on Jan. 22, 1924.

INVESTIGATOR.

MINING STOCKS

Weeks Ended January 12 and 19, 1924

Stock	Jan. 12 High	Jan. 12 Low	Jan. 12 Last	Jan. 19 High	Jan. 19 Low	Jan. 19 Last	Last Div.
COPPER							
Alaska-Br. Col.			*42			*42	
Anaconda	38¼	37	37	37½	36⅝	37	De.15, Ja.21, Q .75
Arcadian Consol.			2			1⅞	
Ariz. Com'l			8½			8⅛	Ja.15, Ja.31 .50
Calaveras			1⅝			1⅜	
Calumet & Ariz			43⅜			44¼	De.7, De.24, Q .50
Cal. & Hecla (New)			18⅜			18½	De. 1, De. 17 .50
Canario Copper	2¼	2 1/16	2⅛	2¼	2 3/16	2⅛	
Cerro de Pasco	47⅞	46⅜	46¾	47	45	45½	Ja. 17, Fe. 1, 1.00
Chile Copper	28⅛	27⅞	27	28⅛	27⅛	27⅞	De.1, De.29, Q .62½
China	19⅞	19⅜	19¾	19	17½	17½	Sept. '20, Q .37½
Con. Coppermines	2⅛	1⅞	2	2¼	2	2	
Copper Range			25			23	May '23, Q 1.00
Crystal Copper	80	71	80	80	74	74	
Davis-Daly			4⅛			4 1/16	Mar. '20 Q .25
East Butte			4¾			5	Dec. '19, A .50
First National	30	30	30	35	35	*35	Feb. '19, SA .15
Franklin			1			1	
Gadsden Copper	*42	*35	*42			*42	
Granby Consol	16½	15	15	14⅝	13⅝	14⅛	May '19, Q 1.25
Greene-Cananea	16¼	14⅝	15⅝	15¼	15	15	Nov. '20, Q 1.50
Hancock			1⅜			1⅜	
Howe Sound	3	2⅞	2⅞	2⅞	2⅞	2⅞	Ja. 2, Ja. 15 .05
Inspiration Con	27⅛	25⅞	26⅜	26⅛	25	25⅛	De. 20, Ja. 7, Q .50
Iron Cap	3⅝	3⅜	3⅜	2¼	2⅛	2¼	May 23, K .15
Isle Royale			19½			18	Se. 1, Se. 15, .50
Jerome Verde Dev.	2	1⅞	1¾	1⅞	1⅝	1¾	
Kennecott	35⅛	34⅝	35	35⅛	34⅝	34⅝	De. 7, Ja. 2, Q .75
Keweenaw			1			1	
Lake Copper			1⅝			1⅜	
Magma Copper	33⅛	33⅛	33⅛	32⅛	32	32	Jan. '19, Q .50
Mason Valley	1⅞	1⅝	1¾	1⅝	1⅜	1⅜	
Mass Consol.			1			*55	Nov. '17, Q 1.00
Miami Copper	22⅞	22⅛	22½	22⅜	22	22⅛	Fe.1, Fe.13, Q .50
Michigan			1			1	
Mohawk			*35⅛			*31	Se. 22, Oc. 13, 1.00
Mother Lode Con	8⅛	8	8	8⅛	8	8	De. 14, De. 31 .50
Nevada Consol.	13⅜	12¼	12½	12¾	12⅛	12⅜	Sept. '20, Q .25
New Cornelia			18			17	Au.3, Au.20, Q .25
New Dominion	2⅛	2⅛	2⅜	2⅛	1¾	1⅞	
North Butte			2½			2 1/16	Oct. '18, Q .25
Ohio Copper	*75	*73	*75	*86	*72	*84	
Old Dominion			16½			16	Dec. '18, Q 1.00
Osceola			31½			31½	June '23, Q 1.00
Phelps Dodge	†145	†135		†140	†135		De. 20, Ja.2, Q 1.00
Quincy			22			20	Mar. '20, Q 1.00
Ray Consolidated	12	11⅜	11⅛	11⅜	10⅜	10⅛	Dec. '20, Q. .25
Ray Hercules	*20	*15	*15	*23	*22	*22	
St. Mary's Min. Ld			*32¼			*32	No.9, De.11, K 1.00
Seneca Copper	6¼	6	6⅛	6	5¾	5⅞	
Shannon			*45			*50	Nov. '17, Q .25
Shattuck Arizona	6⅞	6⅛	6⅞			6⅝	Jan. '20, Q .25
South Lake			*75			*75	
Superior & Boston			1			*90	
Tenn. C. & C. cfs.	9¾	9	9	9⅛	8⅞	9	De. 31, Ja.15, Q 1.25
Tuolumne			*60			*40	May '13, 1.10
United Verde Ex.	28¾	27⅞	28¾	29	28	28	Ja.1, Fe.1, Q 1.00
Utah Consol.			*3			*3	Sept. '18, 1.25
Utah Copper	65½	64⅜	65	65⅝	64	64	De.3, De.15, Q 1.00
Utah Metal & T.			*42			*40	Dec. '17, .30
Victoria			*75			*75	
Winona			*50			*30	
Walker Mining			5¾			5¾	
Wolverine	3⅜	3⅛	3⅛			3¼	
NICKEL-COPPER							
Internat. Nickel	14⅛	13⅛	13⅜	13¼	13	13⅜	Mar. '19, .50
Int. Nickel pfd	79⅛	78¼	79⅛	80	80	80	Ja.17, Fe.1, Q 1.50
LEAD							
Carnegie L. & Z			3⅛	3	3	3	
National Lead	146	141½	142	140	137½	139½	De.14, De.31, Q 2.00
Natl. Lead pfd	112⅞	112⅝	112⅞	112¾	112¾	112⅝	No.23, De.15 1.75
St. Joseph Lead	22¾	22	22⅝	23	22¼	22⅝	De.9, De.20 .50
ZINC							
Am. Z. L. & S	10	9⅛	10	9⅞	9	9	May '20 1.00
Am. Z. L. & S. pfd	34⅜	30	34⅜	34¼	32⅜	33	Nov. '20, Q 1.50
Butte C. & Z	6	5⅛	5⅞	6	5⅛	5⅛	Mar. '23, .50
Butte & Superior	18⅜	15⅝	18	18	16⅛	16⅝	Je. 15, Je. 30, Q .50
Callahan Zn-Ld	5⅝	5¼	5⅜	5⅜	5⅛	5⅛	Dec. '20, Q .50
New Jersey Zn			145	149	148⅜	149	Ja.31, Fe.9 2.00
United Zinc			*25			*25	
Yellow Pine	*82	*80	*82	*82	*80	*80	Dec. '20, 23 .03
SIVER							
Arvarad			1⅜			1¼	
Batopilas Mining			⅛	⅛		⅛	Dec. '07, I .12½
Beaver Consol	*32	*28	*28⅜	*33	*29⅝	*31	May '20, K .05
Castle-Trethewey	*64	*59½	*60	*65½	*63	*65	
Coniagas	2.30	2.30	2.30	2.30	2.15	2.20	Oc.19, No.1, '23 .02½
Crown Reserve	*74½	*71	*71½	*75½	*73½	*74½	Jan. '17, .05
Kerr Lake	2	1⅞	1⅞	2	1⅞	2	Oc.1, Oc.15, Q .12½
La Rose	*29	*23	*28	*26	*23	*24	Apr. '22 .10
McK.-Dar.-Sav	*13	*12¼	*12½	*13	*12⅜	*12¼	Oct. '22, Q .03
Mining Corp. Can	3.23	3.19	3.20	3.30	3.08	3.25	Sept. '20, Q .12
Nipissing	6½	5⅞	6	6	5⅞	6	Ja.1, Ja.21, QX. .30
Ontario Silver	8	8	8	7¼	6⅞	7¼	Jan. '19, Q .50
Temiskaming	*33	*32	*32½	*32	*32	*32	Jan. '20, K .04

Stock	Jan. 12 High	Jan. 12 Low	Jan. 12 Last	Jan. 19 High	Jan. 19 Low	Jan. 19 Last	Last Days
GOLD							
Alaska Gold	1/16	1/16	1/16			⅛	
Alaska Juneau	1⅛	1	1	1⅛	1	1	
Carson Hill			2½			2½	
Cresson Consol. G	3⅞	3 1/16	3⅜	4	3⅞	3⅞	De.31, Ja.10, Q .10
Dome Mines	20¼	19⅝	19¾	19⅞	19	19¼	De.31, Ja.2, Q .50
Golden Cycle	1.25	1.21	1.25			1.25	Dec. '22, Q .02
Hollinger Consol.	12.60	12.40	12.45	12.45	12.25	12.40	Ja.10, Ja.28, M .05
Homestake Mng.	56	56	56	56	55	55	Ja.19, Ja. 25, M .50
Kirkland Lake	*18	*15	*16½	*26	*24½	*25½	
Lake Shore	3.64	3.57	3.58	3.60	3.57	3.60	No.1, No.15'23Q 0.02
McIntyre- Porcu.	18⅛	17⅞	17⅞	17¾	17½	17½	De. 1, Ja. 2, .25
Portland	*40	*40	*40			*40	Oct. '20, Q .01
Teck-Hughes	1 5/16	1¼	1¼	1⅜	1 3/16	1¼	
Tom Reed	*56	*51	*51	*52¼	*49½	49½	Dec. '19, .02
United Eastern	1 1/16	*73	*80	*88	*76	*87	Ja.8, Ja.28, Q .15
Vipond Cons	*99½	*98	*99	1	*98	*99	
Wright-Hrgrvs	3.25	3.10	3.10	3.10	3.00	3.00	Se.15, Oc.1, Q .02½
Yukon Gold			*75			*75	June '18, .02½
GOLD AND SILVER							
Boston-Mont. Crp	*16	*14	*15	*18	*15	*17	
Con. Cortez	*61	*57	*61	*63	*58	*63	
Con. Virginia	5⅛	3⅞	4½	5⅛	3⅞	3½	
Continental Mns.			2			2	
Dol. Esperanza	*62	*50	*60	*65	*55	*55	Jy. 1, Jy.10, Q .05
Jib Consol			*25			*25	
Premier Gold	2⅜	2⅛	2⅛			2⅛	
Tonopah Belmont	*50	*50	*50	*50	*50	*50	Apr. '23, Q .05
Tonopah Divide	*40	*38	*40			*40	Se.22, Oc.10 .10
Tonopah Exten	1 1/16	1⅛	1 1/16	1 1/16	1⅛	1 1/16	De. 11, Ja. 1 .05
Tonopah Mining	1⅜	1⅛	1⅛			1⅛	Se. 30, Oc. 1 .07½
Unity Gold	1 1/16	1 1/16	1 1/16	1 1/16	1	1	
West End Consol.	*60	*59	*59	*65	*63	*63	Mar. '23, Q .05
SILVER-LEAD							
Ahumada	5	5	5	5⅛	5⅛	5⅜	De.15, Ja.2, X .10
Bingham Mines			17½			18½	Sept. '19, Q .25
Cardiff M. & M			75	68	65	68	Dec. '20, .15
Chief Consol	3½	3½	3½	3½	3⅜	3½	Ja. 11, Fe. 1, Q .10
Columbus Rexall	*31½	27½	27½	28½	25	26½	Aug. '22, .03
Consol. M. & S	45½	44	44⅜	37	34	36⅞	Oct. '20, Q .62½
Erupcion	1⅞	1⅞	1⅞	2	2	2	De.15, Ja.2, X .125
Federal M. & S	9½	9⅜	9⅜			9½	Jan., '09 1.50
Federal M&S pfd	44¼	43¼	44⅜	44⅞	44	44½	No. 26, De. 15, 1.75
Florence Silver	*16½	*14	*14	*14½	*12½	*14½	Apr. '19, Q, X .01
Hecla Mining	9¼	9⅛	9⅛	9¼	8⅝	8⅝	No. 15, De. 15 .25
Indian Mines	*65	*62	*65	*66	*63	*64	
Iron Blossom Con	*32	*32	*32	*31	*31	*31	Oct. 25, '23, .02
Marsn Mines			*14	*12	*12	*12	June '21, I .02½
Park City	4.00	4.00	4.00	4.15	4.15	4.15	Jan. '24 Q .15
Park Utah			4			4	De. 8, Ja. 2, Q .15
Prince Consol.			*75			*75	Nov. '17 .02
Silversmith	*31	*30	*30	*32	*30	*32	De. 31, Ja. 10 .02
Simon Silver-Ld	*2	*1	*1	*1	*1	*1	
Tamarack-Custer	1.30	1.35	1.35	1.38	1.35	1.35	Se.30, Oc.1, K .02
Tintic Standard	3.80	3.75	3.80	4.05	3.95	4.05	Ja.5, X .25
Utah-Apex			2⅞			2⅞	" ne '23, Q, X .50
IRON							
Bethlehem Steel			53½	56	53¾	55¼	De.1, Ja.2, Q 1.25
Char. Iron	1	1	1	1	1	1	
Char. Iron pfd	2 13/16	2 13/16	2 13/16			2 13/16	
Col. Fuel & Iron	27½	25	25⅝	27	25¼	26⅝	No.10, No.26 Q 2.00
Col. F. & I., pfd			102			102	Feb. '23, Q 2.00
Gt. N'thn Irn Ore	30	28½	28¾	29½	28	28⅝	De.10, De.27 2.00
Inland Steel			46			46	No.15, De.10 .62½
Mesabi Iron	8⅛	7½	7⅞	7⅞	7	7	
Replogle Steel	12⅝	11¾	12⅛	13⅜	11⅜	13⅛	
Republic I. & S	53⅝	51⅛	53⅛	55	51	53⅜	May '21 1.50
Republic I. S. pfd	90	89	90	91	89¾	90	Mh.10, Ap.1QX 2.75
Sloss-Shef. S. & I	62	59⅞	61	62	58	60½	Feb. '21 1.50
Sloss-Shef. S&I pfd			84			84	De.20, Ja.2, Q 1.75
U. S. Steel	100½	99½	99¾	101⅝	98⅝	100½	No.29, De.29, Q 1.50
U. S. Steel pfd	120	119⅞	120	120½	120	120	No.4, No.28, Q 1.75
Virginia I.C.&C	53	52	53			53	De. 15, Ja. 2 1.50
Vir. I.C.&C. pfd	79½	79½	79½			79½	De. 15, Ja. 22 2.50
VANADIUM							
Vanadium Corp	31⅜	30⅜	30⅛	31⅜	29⅜	30½	Jan. '21, Q 1.00
ASBESTOS							
Asbestos Corp.	32	25½	32	33½	30	30	Se.29, Oc.15 Q 1.00
Asbestos Corp. pfd	62	58½	62	61⅞	59½	59½	Se.29, Oc.15, Q 1.50
SULPHUR							
Freeport Texas	13⅞	12⅜	13	12⅜	11⅛	11⅜	Nov. '19, Q 1.00
Texas Gulf	65¼	60⅜	60⅛	64	62	62	De.1, De.15QX 2.00
PLATINUM							
So. Am. Gold & P.	3⅛	3	3	3⅝	3⅛	3⅛	
MINING, SMELTING AND REFINING							
Amer. Metal	45⅝	42	45	45	44	45	No. 17, De. 1, Q .75
Amer. Metal pfd			108½			108½	No. 19, De. 1, Q 1.75
Amer. Sm. & Ref	60⅞	58	58	59	57⅛	58⅜	Ja. 11, Fe. 1, Q 1.25
Am. Sm. & Ref. pfd	99½	97	98	99⅞	98⅛	99⅜	Fe. 20, Mh. 1, 1.75
U. S. Sm. R. & M	22⅜	20⅞	22⅛	22½	20⅛	20⅜	Jan. 21, Q .50
U. S. Sm. R. & M. pf.	41	39½	40⅛	40½	40½	40⅛	Ja. 7, Ja. 15, Q .87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually, M, Monthly. K, Irregular. I, Initial. X, Includes extra.

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